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Report on Exploratory Investigations of Agricultural Problems of ALASKA

MISCELLANEOUS PUBLICATION No. 700

AGRICULTURAL RESEARCH ADMINISTRATION
UNITED STATES DEPARTMENT OF AGRICULTURE

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For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price 60 cents

842849—50——1

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WASHINGTON, D. C. Issued December, 1949

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THE EXPLORATORY INVESTIGATIONS

The 1947 Department of Agriculture Appropriation Act (approved June 22, 1946) provided a nonrecurring, immediately available appropriation of $20,000 to the Office of the Administrator, Agricultural Research Administration, for special exploratory investigations of Alaska, to determine the basic problems underlying potential agricultural development in appropriate areas of Alaska, as a guide to the development of future agricultural research in the region. A task group of eight technical employees of the Department conducted the exploratory investigations during the summer of 1946.

They were assisted by Department employees and other Federal and Territorial employees stationed in Alaska. The Agriculture Subcommittee of the House Committee on Appropriations, which initiated the provision for the exploratory investigations, assigned its Executive Secretary to accompany the task group.

The members of the task group who conducted the exploratory investigations for the Agricultural Research Administration, United States Department of Agriculture, and who prepared this report were: O. S. Aamodt, head agronomist and leader of the group, C. E. Kellogg, head soil scientist, I. J. Nygard, senior soil scientist, Roy Magruder, principal horticulturist, D. A. Savage, senior agronomist, and A. D. Edgar, agricultural engineer, of the Bureau of Plant Industry, Soils, and Agricultural Engineering; and N. R. Ellis, principal chemist, and H. E. Kemper, veterinarian, Bureau of Animal Industry. Arthur Orr, executive secretary of the Agriculture Subcommittee of the House Committee on Appropriations, accompanied the task group. The task group also was assisted by C. S. Wilson, entomologist, Bureau of Entomology and Plant Quarantine, and J. S. Leekley, associate biologist, Bureau of Animal Industry, already stationed in Alaska, and by other Federal and Territorial employees, farmers, and other residents of Alaska.

THE PROBLEMS OUTLINED

Farming in Alaska was considered in the exploratory investigation as an auxiliary to military, transportation, mining, fisheries, forestry, and industrial development. Present and potential agricultural areas were examined to determine their extent, relative productivity, livestock requirements, ability to support population, prospective products, markets, and technical problems of development. The development of Alaska is important to the future welfare of the United States. Alaska will play an important role as a source of fish, minerals, and timber and as a base for world air commerce.

BACKGROUND OF ALASKAN CONDITIONS

The greater part of Alaska is unsuitable for any kind of crop production. Where range might be adequate for grazing stock for a few months in the year, there is usually not enough associated land suitable for growing feed crops for carrying the animals over the winter.

The soil areas where agriculture can be carried on are small and scattered. Perhaps a rather large total area could be farmed if the United States were to become desperate for land. The task group estimates that there probably is not more than a million acres of suitable farm land, though much more might be developed if the local need for agricultural products should become critical.

Partly because of its isolation and the high cost of transportation, prices of practically all products are very high in Alaska. This is true of the things the farmer has to sell and also of the things he must buy—his machinery, fertilizer, fencing, lumber, and other supplies. The cost of living is high, and so are the wages of common labor that vegetable farmers must employ.

Although some export trade may develop in a few agricultural specialties, farmers will need to depend primarily on local markets. This means they will need to produce the kinds of products required by the people living in Alaska, who are engaged in mining, fishing, maintenance of communications, etc. Their prices are, and will need to be, higher than those ordinarily received by farmers for the same products in the States. To the extent that freight rates are reduced, farmers can pass this saving on to consumers, but there is much doubt that prices can be reduced in other ways if farming is to be successful.

A good many successful farms have been in operation in Alaska for several years. The families on these farms have learned the potentialities and understand many of the handicaps. They like to live in Alaska.

In the principal mainland areas—Matanuska, Tanana, and Kenai—agriculture consists chiefly of dairying and the production of potatoes and other vegetables, mostly on a limited scale as judged by standards of production in the States. Some mixed stock farming is in progress, principally in the Matanuska Valley, with hogs, poultry, sheep, goats, and a few beef cattle.

Most students of agriculture in Alaska with whom the problems were discussed, believe that farming is sure to continue and expand as a basic industry and that livestock must occupy a greater part in farming operations in the future if stability and success are to be achieved. Since only about 15 percent of the food requirements of the people are now supplied from Alaskan farms, there is abundant need and opportunity for production of animal food products. The centers of livestock population and the type of product marketed are in large measure the result of experience over many years. The local conditions, such as grazing land available, crops that can be grown, climate, transportation, and markets, have made the present situation what it is for the most part. It should not be overlooked, however, that new generations of farmers will come, and they may succeed where many of their predecessors have failed.

Alaska is capable of producing 80 to 90 percent of its own requirements for agricultural products, instead of about 15 percent as at present. Although some Alaskan wool of superior quality is now being shipped to the States, very few agricultural products can be produced economically enough in Alaska to warrant exportation. The possibilities for agricultural expansion in Alaska may, therefore, be limited to the requirements of its own people, to the increasing demands of a steadily growing population, and by the ability of the Territory to solve the many perplexing problems associated with production. Agriculture is fairly certain of steady expansion in areas where it is now on an established basis. Expansion beyond the better farming and stock-raising areas can be made in the face of greater problems and difficulties, but it will depend upon future population increases of greater magnitude than are now indicated.

The present high cost of land clearance on the mainland of Alaska is a serious limiting factor to stock farming and range livestock production. Most of the cleared land is now of necessity devoted to the production of cash crops (potatoes and other vegetables) and dairying. The Territorial requirements for potatoes can be met without great expansion of the present production. Increased attention will be directed in the future to dairying and the raising of poultry, hogs, beef cattle, sheep, and goats. A steady expansion in the acreage of cleared land is also certain to encourage the production of more forage crops and livestock. Diversification in these directions is necessary before proper land use and a permanently successful system of agriculture can be established in Alaska.

Increased production and improved storage of better forage crops for winter feed in all agricultural areas of Alaska would make it possible to increase greatly the present herds of beef cattle and sheep. This would also enable the livestock farmer to utilize the extensive areas of summer range adjacent to or accessible by rail from the principal farming areas. Most of the livestock could be fed for a while on valley crops in the fall and then slaughtered for local consumption, and only the breeding herd would be carried over the winter.

RESEARCH NEEDS

Agricultural research is urgently needed to develop basic information for the establishment and maintenance of a permanent and efficient agricultural industry in Alaska. Such information is necessary to guide new settlement, to help gardeners and part-time gardener-farmers in the towns and villages as well as in the country, and to provide a foundation for improving the living standards of the farmers in the Territory. These people do not have the great backlog of knowledge gained through experience and research that is available in the continental United States. In addition, there is a pressing need for sound, reliable information that can be placed in the hands of new settlers. Ill-advised and glowing accounts of Alaska, emphasizing its potentialities and omitting the handicaps, are encouraging many veterans and other settlers to take up land of uncertain quality, often far from markets. Further, some of these people have had no experience in farming, either in Alaska or with crops adapted to the soils of Alaska. Settlement by such families, or by any families, on poor soil, can lead only to waste, disillusionment, and bitterness.

Some important testing and observational research has been done by the Alaska Agricultural Experiment Station, but there has been very little fundamental research that gets at the unique problems of the Territory. It appears that those researches should be emphasized now that are most critical and that can be conducted without extensive laboratories or other permanent facilities within the Territory.

Facilities

For several reasons, including the scarcity of building materials, it does not appear practicable to attempt immediately the establishment of additional research stations in Alaska that would involve a significant amount of building, land purchase, or laboratory facilities, badly as some of the research requiring such facilities is needed. Rather, it would seem more feasible to undertake work on problems of basic importance, both in themselves and to other research, that can be initiated at once with existing facilities.

Soil Studies

Detailed soil classification and mapping should be undertaken within the two principal farming areas, the Matanuska Valley and the Tanana Valley, with some work in the area near Anchorage and Homer. Vitally important fertility studies should be begun at the same time in cooperation with existing farmers and as an integral part of the soil classification and mapping project. By beginning the classification and mapping in the areas where experience is available, it will be possible to develop rather accurate estimates of the responsiveness of the soils to management and of their management requirements. Having this established, soil scientists can classify and map the soils now unoccupied and make valuable and reliable recommendations to prospective settlers. It would be important also to have some work in farm management closely and intimately associated with that in soil classification, mapping, and management. Soil erosion problems will need to be studied when the Soil Survey results bring them to light.

Field and Horticultural Crops

Research is needed to develop reliable information regarding crop and varietal adaptability and improvement, cultural requirements, control of diseases, harvesting, storage, processing, and handling of cereal crops, potatoes, vegetables, and small fruits. Pasture and range management research should be undertaken to develop superior adapted strains of grasses and legumes, and to devise the best methods of establishment, production, handling, and storage of feed reserves to help develop and maintain successful farm enterprises and farm communities.

Climatic Data

A study of climatic influences should be made to organize, define, and analyze the various distinct agro-climatic conditions prevailing in the different parts of Alaska. This would include analyses of the precipitation pattern in various parts of Alaska in comparison with areas in the United States and other parts of the world, as well as comparative studies of temperature and relative-humidity similarities between Alaska and other regions. These studies would provide more exact information than is now available to guide the development of research on crop possibilities in Alaska.

Livestock Production

A central research station located in the Matanuska Valley and two substations (probably one in Tanana Valley and one on the Kenai Peninsula) should be established when material is available to conduct research in livestock breeding, feeding, and management problems peculiar to those areas. Research at the central station would consist of both fundamental and practical experimentation in problems of feed production, harvesting, preservation of feed crops, and pasture evaluation; the feeding value of locally produced forages and concentrates; nutrient requirements of cattle, raising of herd replacements, and breeding of livestock adapted to the region; the dissemination, on an experimental basis, of superior germ plasm among farm herds; and the processing and distribution of milk and milk products. Research at the substations would be of a more applied or demonstration nature, in keeping with findings at the central station but adapted to existing local conditions. Exploratory investigations should first be undertaken to determine in more detail the nature of the particular problems requiring early attention and the most desirable areas in which to locate the stations. Details of the station layouts and research programs would be formulated during the interim. These investigations would be followed by the establishment of facilities for detailed research.

The raising of fur-bearing animals has potentialities which should be given attention.

Agricultural Engineering

Research is needed on engineering problems such as land clearing, building construction, farm machinery, and use of electricity, and cooperation is necessary to solve problems of plant and animal production, storage, and housing.

Insect Pests

The nature and importance of crop-insect problems in areas other than the Matanuska Valley are little known, and further determination of kinds of pests and type of attack is needed. The relation of farm practices to insect damage and the effectiveness of insecticides against the pests found will require continuing investigations for at least a few years. Farmers should have guidance in initial application of the control measures developed.

Rural Living Conditions

A research program looking toward the improvement of family situations in Alaska should begin with a study of present conditions and practices which affect family living. This should include surveys of food consumption, from which the nutritive value of family diets can be computed and their adequacy evaluated. The cost of food should be studied and factors affecting food use analyzed. Similar surveys of the use of clothing and other goods and services and of housing facilities should be made.

Farm Management and Marketing

Research is necessary to determine the types of farm organization and farm practices best adapted to the various soils in Alaska in order to increase the efficiency of agricultural production, overcome to the greatest practicable extent the deficit in agricultural production, increase the farm income, and establish a stable and profitable farm economy. Studies are needed on existing market outlets, transportation costs, distribution facilities, and market prices for locally grown and shipped-in products as a basis for an economic analysis of potential agricultural development in Alaska.

Relation of Agricultural Research to Other Programs in Alaska

It is recognized that the development of an agricultural research program cannot be conducted successfully without due regard to other programs that may be undertaken for the improvement of conditions in Alaska. It is planned, therefore, to coordinate such agricultural investigations as may be undertaken by the Department of Agriculture with the programs of other government agencies for the improvement of transportation, marketing, fishing, and for the national defense. These programs are intimately related to an orderly and progressive type of agriculture. Cooperation also would be effected with various public and private agencies that are willing to assist and have facilities that can be used in an agricultural research program.

Estimated Cost of Proposed Research

The task group recommends the inauguration of an agricultural research program in Alaska to begin in 1948 at an anticipated cost of $150,000 for the first year and to be developed over a 5-year period to a program costing three or four times that amount. This would be in addition to expenditures by the Territory.

SOIL PROBLEMS AND PROPOSED RESEARCH

AMOUNT OF ARABLE LAND

The late C. C. Georgeson, who was in charge of the Alaska Agricultural Experiment Stations from their establishment until 1928, made one of the first estimates of the amount of land that could be made available for agriculture in Alaska. He had traveled extensively in the Territory and had a background of experience in agriculture. Seeing hardy vegetables grow so luxuriantly in gardens, he became enthusiastic about the agricultural possibilities of the Territory. Thus, when asked to submit a figure on the amount of land available for agriculture, he gave an estimate of 41,600,000 acres that could be tilled and an additional 22,400,000 acres that could be pastured, out of a total of 365 million acres. For a long time no one was in a position to challenge these figures. They are now believed to be entirely too high, but they served an important purpose in dispelling the old popular misconception that Alaska is a forbidding land of ice and snow.

The task force estimates that probably not more than about 1 million acres is suitable for farming, though much more might be developed if the need for local production should become critical. The economy of production in an expanded acreage, under less favorable conditions, would be questionable when considered in terms of possible imports from the continental United States and Canada.

Summer range and pastures are extensive in the Territory. Limited supplies of grain and harvested forage for winter feeding present the main obstacle to livestock production.

SOIL AREAS OF MOST IMMEDIATE CONCERN

Tanana Valley in central Alaska in the neighborhood of Fairbanks has an established, going agricultural community. Generally, the soils are developed from relatively young stream alluvium or from mantles of silty, very fine sand thrown up by the wind over the gently sloping upland on the margins of the valley. At depths of 2 feet or more the soils are frozen; but whether frozen or not, all the soils are too cold for growth of roots of crop plants below 12 to 18 inches. For potatoes and vegetables, fertilizers are required from the very start. Only a few thousand acres have been cleared for crops and pasture, but there is room for expansion.

Matanuska Valley lies near the village of Palmer and some 40 or 50 miles northeast of Anchorage. Generally, it is a plain with a base of outwash gravels and cobbles, covered with wind-blown, very fine sand to depths up to 6 feet. Soils developed from the areas with the deep covering are good, but the soil becomes poorer as the fine sandy covering feathers out at the edges and to the west. Here the soil is not permanently frozen, except under deep peat, but still the subsoil is very cold—too cold for the extension of the roots of crop plants. Several thousand acres are cleared in this area—considerably more than in the Tanana Valley—and now about 250 farm families are in the whole area. As near Fairbanks, much of the best soil near the trading village of Palmer is held by nonresident owners who pay no taxes, and new settlers are going into the western portion, where the surface covering of fine soil is thin. This is the most promising area in Alaska, and its future seems assured, but there are a great many serious problems that must be solved for reasonably good success.

Part-time farming area in the neighborhood of Anchorage.—Near the city of Anchorage is a considerable area of nearly level to undulating loamy fine sand and fine sandy loam soils underlain by gravel. The soils are Podzols, resembling those of the sandy plains of the northern Lake States. They are hardly productive enough for commercial farming, but their location gives them a great advantage for use by people working in Anchorage, who can live on small tracts of a few acres and make important supplements to their living with vegetables and poultry.

The Homer area on the Kenai Peninsula is a small area of reasonably good soil, but the community is handicapped by isolation. Again, much of the uncleared land that would be suitable for farming is held by nonresident owners and not available for settlement at present.

Miscellaneous areas.—In addition, small areas suitable for gardening, with small plots, cold frames, and greenhouses are scattered throughout the Territory. Other spots could be used for one up to half a dozen dairy farms, and some areas on Kodiak and in the Aleutian Islands are suitable for grazing.

MOST IMPORTANT SOIL PROBLEMS

The shallowness of the true soil, the youth of many of the soils, the mellowness of the surface soil, the low temperatures of the soil a few inches beneath the surface (whether frozen or not), the shallowness of roots, the great importance of soil organic matter, and the need for rapid warming for early nutrient supply are basic facts about Alaskan soils. Further, the contrast in soil climate and environment between virgin and cultivated soils of the same type is extreme.

Soil classification and mapping are urgently needed, primarily as a basis for classifying the available experience, which is considerable in the Matanuska and Tanana Valleys; for outlining, planning, interpreting, and extending much of the other agricultural research; and for recommending areas for settlement and practices for new settlers.

Recommendations for other soil researches are all dependent on having a sound soil classification, and the classification itself needs the support of analyses of existing farms through farm management research and research with the fundamental soil-management practices.

Other soil problems which call for investigation are: Fertilization; tillage and land clearing; organic matter; drainage; permafrost; irrigation; soil erosion; and soil blowing. Special studies might be carried out near military camps to ascertain the possibilities for vegetable growing and even dairying, for the morale value of fresh vegetables and milk.

SIGNIFICANCE OF THE SOIL PROBLEMS

The agricultural potentialities in Alaska are of greatly increased concern because of the development of other industries and especially of communication centers in the Territory. Local sources of food are urgently needed, and many people are seeking opportunity as farmers in Alaska. Yet the amount of soil suitable for farming is very limited, and much of it is intermingled with land wholly unsuitable. Cost of land clearing is very high—about $100 per acre—and substantially the same for poor soil as for good soil. Further, because of the short growing season and very long summer days, cropping systems and soil-management methods different from those followed in the United States will be required.

Experience has already demonstrated that, with proper management, economical farming for local markets can be carried out on some of the soils. But the established farmers have many difficult problems and need help. The first step is fundamental information about the various types of soil so that knowledge gained from experience can be applied to specific farms. The good results of one farmer cannot be duplicated by another unless the soils are similar. Certainly unless settlers avoid the unsuitable land and adopt soil-management practices adapted to the special soil conditions in Alaska and on their specific farms, failures are inevitable—failures that will result in severe losses to individuals and communities, and will create serious social problems.

With accurate soil maps of areas of prospective settlement and definite recommendations for the use and management of the specific soil types, as developed by research and the analysis of experience to date, such failures may be avoided and orderly settlement expected.

PROPOSED RESEARCH

The principal types of soil to be found in settled areas and in other areas of agricultural promise near rural or urban settlements should be examined to determine their character, crop adaptability, management and requirements, and extent. Detailed maps showing the soil types would be prepared for the regions of agricultural promise, beginning in the areas around Fairbanks and Palmer, where considerable farm experience is available, and extending to other agricultural and potential agricultural areas as rapidly as possible. Growing crops and grasses would be studied in relation to soil conditions, and samples of the soils, along with enough samples of the vegetation, would be collected and analyzed to establish the principal chemical relations that are affecting the nutritive value.

During the first summer careful analyses would be made of the soil-mangement practices followed and the results being obtained now by practical farmers in relation to soil type. On the basis of these analyses, field experiments would be established on active farms, in cooperation with the farmers, to determine the responses of the principal soil types to the use of fertilizer, lime, and other approved management practices.

From the observations made in the field, from the results of the management research, and from the analysis of experience on existing farms, the crop adaptability, yields, and management requirements for each soil type would be developed in definite form for use in making recommendations to established farmers and prospective settlers regarding the suitability of specific lands for use and appropriate crop rotations and systems of soil management.

FIELD-CROP AND RANGE PROBLEMS AND PROPOSED RESEARCH

The development and use of improved forage crops for winter feed on the southwestern Alaska islands, where range livestock production is now limited by the amount of native grass available for winter grazing along the beaches, would greatly stabilize and expand the industry of these islands. This would also enable the island stockmen to utilize more adequately the vast amount of range forage available at higher altitudes through the comparatively long growing seasons in this area, where the climate is tempered by the Japanese Current.

The production and preservation of nutritious forage crops for winter feed is the principal problem confronting the livestock producer of Alaska. Weather conditions are rarely satisfactory for producing well-cured hay. Native grasses are seldom cut at the proper stage of growth for best results. They are said to be lacking in food value when mature and weakened in vigor when cut or grazed annually. The rough, hummocky nature of the natural grasslands makes it difficult to mow the grasses for hay or ensilage. The old growth left on native grasslands hinders mowing, delays thawing, and retards new growth. Surface tillage offers possibilities for leveling hummocky grassland and for adding tame species to the native mixture. Preburning constitutes a practical means of removing old growth, lowering the frost level, and encouraging new growth, but if done at the wrong time, it may result in a "ground fire" that will destroy most of the humus in the soil.

Native grasses, principally bluetop, are widely distributed in Alaska. They grow surprisingly well nearly everywhere in the Territory, except in the dense shade of forested areas; on extremely wet, swampy land; in the dense hummocky tundra covering of sedges, moss, and other plants that blankets, insulates, and holds the permanent ice layer near the surface; and in the high, rugged, and perpetually snow-covered mountains. Since most of Alaska falls in one or the other of these negative sites for grass production, extensive areas of open grassland occur only on the southwestern Alaska islands, on a part of the Kenai Peninsula, and on burned-over areas on the mainland. However, the native grasses increase rapidly and grow vigorously wherever the better drained lands have their covering of trees cleared or of tundra disturbed.

Bluetop, beach wild-rye, and other tall grasses of Alaska are considered highly nutritious in the early stages of growth but are reported to be seriously lacking in food value in the matured and cured stages of development. However, chemical analyses of the forage collected during these investigations indicated that the plants compare favorably with the tall grasses of the States, except that some of the Alaskan species show a surprising lack of calcium and borderline values for phosphorous. The tall grasses of Alaska also lack the ability to recover from continuous grazing or cutting. Defects in the taller grasses of the Territory are overcome to some extent by the presence of palatable legumes in many areas and by the occurrence of superior species of bunch grasses, chiefly fescue and Arctic bluegrass, at higher altitudes.

Many tame grasses and legumes are well adapted to Alaskan conditions and have possibilities for nutritious forage greatly superior to that of the native species. The more promising tame species include smooth bromegrass, the fescues, bluegrass, yellow alfalfa, alsike clover, red clover, and perennial vetch. Very little is known about how best to establish, manage, and maintain these plants in Alaska. Most of these forage plants, like those in the States, lose much of their food value in late summer and fall. The fescues are promising exceptions. Seed supplies of adapted strains of many of these species, particularly the yellow alfalfa, are difficult to obtain. Seed of the same species from different sources may vary widely in production and adaptation. The possibility of developing improved strains of the better forage species by intensive plant breeding and testing has received scarcely any attention to date. Very little factual information is available as to the proper mixture of grasses and legumes to use for pastures on various soil types.

Hardy varieties of wheat, oats, and barley thrive and usually mature in Alaska and are often used with vetch or peas for bundle feed, hay, or ensilage. However, the cost of growing and producing these annual crops for feed purposes often greatly exceeds that of producing perennial grasses and legumes. Furthermore, the perennials usually complete their growth during the drier part of the season and can then be harvested rapidly. It is much more difficult to harvest the grain-pea-vetch mixtures during the rainy fall season. The grain crops also often become badly infested with weeds, because these crops have to be planted early before weeds can be properly controlled.

Short drought periods occur frequently during the early summer in the Tanana Valley and to a lesser degree in the Matanuska Valley and on the Kenai Peninsula. A perennial plant to be wholly successful in Alaska must be capable of rapid growth and must possess combined resistance to drought, wind, water erosion, severe cold, and soil heaving.

SIGNIFICANCE OF THE CROP PROBLEMS

The development of Alaska is an important link in the future security of the United States. The Territory will play an important role as a source of fish, fur, mineral, and timber supplies, and as a base for world air commerce. For protection and to serve air commerce, bases must be developed and maintained. All of this points to the need for dependable local sources for certain essential foods, agricultural services, and a stabilized population. Public interest is being aroused in these possibilities, and many returning service men plan to settle and farm in Alaska.

Farming in Alaska presents many problems with which those who have farmed elsewhere are unfamiliar. The long winters, the short growing season and its long daylight, the relatively raw soils resulting from the climatic complex, and the effect of all these factors, not only on growing the crops but on their food and feed values as related to the longer winter indoor-feeding period for livestock, must be understood for success. Some information has been collected on crop possibilities for limited areas, but this must be expanded to include all of the areas potentially adapted to settlement.

Livestock feeds are the greatest crop need of the area. In a dairy program, the long winter feeding period requires that as much tilled land as possible be devoted to feeds and forage. This in turn means that native forage should be utilized as range and pasture to the fullest extent possible during the growing period. Studies to determine nutritional values, including minerals and vitamins, of native grass and browse plants are therefore of paramount importance. The length of time during which such range can be used and, conversely, the periods during which, because of snow, range cannot be used and animals must be provided for by other feeds, must be balanced in total feed supplies.

Similarly, the nutritional values of cultivated crops as foods and feeds should be determined with particular reference to those nutrient items that must be supplied in special amounts because of the long winter indoor-feeding period. This is particularly true of minerals and vitamins. The possibilities of feeds for dairy animals need special attention because of these factors and their relation not only to the welfare of the animals, but also to the food value of the dairy products.

The relationships of crop composition to the soils and the fertilizer and management practices necessary to produce food and feed of requisite nutritional make-up are an integral part of needed information. These problems are in addition to the more obvious ones of what to grow and how to grow it.

PROPOSED RESEARCH

In cooperation with soil and engineering specialists of the Bureau of Plant Industry, Soils, and Agricultural Engineering, livestock specialists in the Bureaus of Animal Industry and Dairy Industry, and members of the Alaska College and Station, general studies should be made of crop adaptation and responses on different soils in the areas promising for development, with similar studies of native range and browse plants in relation to soil types. Yield and quality data, together with information on optimum methods of management, would be based on station and farm experience, insofar as possible. Plant and grain samples would be analyzed chemically for nutritional values. Work during the first year must be exploratory in order to determine the items requiring most intensive later attention.

HORTICULTURAL CROP PROBLEMS AND PROPOSED RESEARCH

MOST IMPORTANT POTATO PROBLEMS

Some of the more important potato problems needing solution are: (1) Tillage and soil-management practices to make early planting possible; (2) fertilizer ratio, amount, and method of application to produce largest yield, early maturity, best edible quality, and best storage quality; (3) determination of varieties best adapted and of best quality; (4) breeding of early-maturing, highly edible, productive, disease- and insect-resistant varieties of good storage quality, adapted to different production sections; (5) production of disease-free seed potatoes; (6) control of diseases and insects; (7) factors affecting storage life; (8) how, when, and how much to irrigate; (9) maintenance of organic matter and soil fertility; (10) most efficient tillage and harvesting methods and machinery; and (11) weed control.

MOST IMPORTANT VEGETABLE PROBLEMS

Some of the more important vegetable problems needing solution are: (1) Determination of present-day varieties of vegetables adapted for special uses and to different sections of Alaska; (2) tillage, soil management, time and method of planting, fertilizers, and irrigation practices as affecting early maturity, total yield, edible quality, and storage quality; (3) control of diseases and insects through use of resistant varieties, commercial pesticides, and improved machinery for application of pesticides; (4) methods of storing various vegetables; (5) labor-saving tillage, harvesting, and packing methods and machinery; (6) varieties adapted and methods of growing tomatoes and cucumbers in small home hothouses; and (7) weed control.

MOST IMPORTANT SMALL-FRUIT PROBLEMS

The research work with fruits should include (1) selection and testing for superior qualities of individual plants of native or wild strawberries, currants, red raspberries, highbush cranberries, lowbush cranberries, serviceberry, salmonberry, and other fruits; (2) breeding to improve dessert and processing qualities and retain winter hardiness of native fruits; (3) experiments on effect of time and method of planting, irrigation, use of fertilizers, mulching, and pruning on yield, quality, and winter hardiness; and (4) introduction and testing of varieties of fruit from other northern regions, such as Canada, the northern United States, and Russia.

PROPOSED RESEARCH

The horticulturists should spend approximately half their research time on potatoes and the other half on other vegetables, with most of the early emphasis on leaf and head lettuce, cabbage, cauliflower, celery, peas, and root crops. If a horticulturist especially trained in small fruits were available, he could be located either at Fairbanks or Palmer. Work with cranberries should be done in southeastern Alaska, near Juneau. All the research would be planned so as to obtain maximum cooperation between Federal and Territorial agencies.

ECOLOGICAL PROBLEMS OF PLANT AND ANIMAL ADAPTATION AND PROPOSED RESEARCH

CLIMATIC INFLUENCES AND PROBLEMS

The objective of this study would be to organize, define, and analyze the various distinct agro-climatic conditions prevailing in the different parts of Alaska and to compare them with various agro-climatic regions of the United States, Canada, and northern European countries in order to ascertain "climatic analogues." These climatic analogues are areas in the United States and the other countries that are enough alike with respect to some of the major weather characteristics affecting crop production, particularly during the growing period, to offer a fairly good chance for the success of plant material transplanted from one such area to another.

All available meteorological data of weather stations of Alaska and the United States can be utilized as the main source of material for this study. The crops grown, the crop geography, and the physiographic and soil characteristics of the various physical belts of Alaska would be considered and presented.

The elements of comparison used in such a study are mean monthly and yearly temperatures, average monthly, seasonal, and yearly precipitation, precipitation-effectivity indexes and ratios, relative humidity of the atmosphere, and latitudes.

In addition to the climatic analogues based on similarities in the precipitation pattern and as many of the elements of comparison as possible, another comparative study without regard to the precipitation pattern and based mainly on the temperature and relative-humidity similarities can be undertaken in order to ascertain additional, or more exact, climatic analogues for crops.

These phenological comparisons, as well as some comparative studies of the summation of the accumulated day-degrees required to bring a crop to maturity, can be made available in considerable detail.

PROPOSED RESEARCH

Climatic-phenological analogues of various areas of Alaska from meteorological and phenological data on Canada, Siberia, Finland, Sweden, Norway, and the United States should be formulated. One could also formulate off-latitude analogues for crops of wide elasticity to photoperiodic responses. The work would be done in Washington, D. C., from available reports and publications. It could be completed in 1 year.

LIVESTOCK PROBLEMS AND PROPOSED RESEARCH

The future development of Alaskan industries is largely contingent upon vigorous agricultural enterprises capable of supplying at a reasonable cost the major part of the food for the population. Expanded sources of such foods as milk and its products are urgently needed. Sufficient desirable farm land is available to support an enlarged agriculture. High food costs and an increasing population are creating additional interest in farming.

Dairying is receiving much attention and is becoming a major enterprise in the desirable agricultural areas. Livestock farmers have met great obstacles in developing adequate feed supplies and in maintaining and improving the productivity of their herds. Importation of both feed and cattle has accounted for high production costs. Farmers have not had available helpful information emanating from a vigorous research program to guide them in developing efficient dairy-farm enterprises. Consequently, production is low, production costs are high, and the industry has not been able to expand sufficiently to meet the demands for milk and other livestock products.

Beef cattle and sheep are raised under ranch conditions on islands along the southern coast and in small farm herds in the interior under more or less diversified general farming conditions. The problems differ somewhat but have in common the need for concerted breeding programs, adequate feed sources and supplies, and efficient methods of feeding to keep down losses from nutritional disorders and low quality of products.

The potential market for meat is sufficient to allow a several-fold expansion in production. Swine raising at present is largely based on the feeding of garbage from military posts and cities. Greater use of forage crops during the summer months is needed both as an adjunct to the garbage supply and as a source of vitamin and mineral factors. Some expansion of swine production appears to be possible through utilization of cull and waste vegetable and other crops.

Next to dairying, poultry raising offers a good opportunity to the farmer or small-town dweller to supplement the family food supply as well as the income. In the larger communities intensive poultry raising on a full-time basis seems feasible because of the market possibilities for eggs and poultry meat. Considerable dependence would need to be placed on imported feeds. Research is needed to determine the best methods of feeding and the requirements in feed nutrients under Alaskan conditions.

Livestock production has been limited by feed supplies. Until feeds can be produced of sufficient diversity for use in livestock rations, serious restrictions must continue. Undoubtedly a part of the supply of concentrate feeds required can be imported, especially for poultry and dairy cattle, but the growing, harvesting, and storage of forages present a problem that must be solved. Economy of production must, of course, be considered along with physical possibilities.

The scientific approach to the difficult problems confronting the Alaskan farmer is the surest way to develop efficient livestock enterprises. A vigorous research program, therefore, is needed. Knowledge gained from such research will greatly increase the productivity and efficiency of the present farmers and will guide new settlers in developing livestock farms.

PROPOSED RESEARCH

Basic and applied research is needed to develop efficient methods of livestock farming in the several agricultural areas in Alaska. Research is recommended specifically to (1) determine the nutrient requirements of dairy animals of all ages maintained under Alaskan conditions; (2) determine the chemical composition and nutritional values of Alaskan feeds; (3) determine the prevalence of nutritional (mineral) deficiencies in livestock in Alaska; (4) develop appropriate and efficient methods of raising livestock replacements; (5) evaluate pastures and pasture crops used for dairy cattle in terms of milk production; (6) develop efficient methods for preserving feed crops under Alaskan conditions; (7) develop high-producing types of livestock adaptable to Alaskan conditions; (8) increase the productivity of Alaskan livestock by providing superior germ plasm to farmers through artificial insemination and bull-leasing programs; (9) determine the physiological reactions of livestock to existing climatic conditions; (10) determine causes of livestock diseases and methods for their control; (11) develop efficient methods of producing and handling milk on the farm to insure a high-quality product; and (12) develop efficient ways of processing milk and manufacturing milk products for distribution under Alaskan conditions.

There can be little doubt that many plants on the Alaska ranges in addition to the few enumerated earlier are toxic, in small or large degree, to livestock. Stockmen are totally undecided, as is so frequently the case, regarding the identity of the poisonous plants and their ultimate effects on livestock. Studies devoted to the toxicity to animals of Alaska's poisonous plants, particularly plants of families known in the United States to be noxious, are an urgent need. Such investigations should provide knowledge that would be a distinct boon to the Territory's struggling livestock industry.

Particularly in the field of nutrition, investigations into poultry health in Alaska would pay dividends. Some effort should be made to determine the value of locally grown feeds as compared with the feeding mixtures shipped in from the States. In addition, a thorough survey of poultry diseases should be made, particularly in the Palmer and Fairbanks areas. It is advisable to make the investigations into poultry health while the Alaska poultry industry is still small. Early inquiries may facilitate elimination of diseases that have already gained a foothold and assist in limiting further introduction of disease.

Because the livestock industry is so small at present it should not be difficult to make a complete survey of the parasite situation in farm animals. Some of the many matters which could be profitably investigated include the reasons for the relative absence of many of the more common internal parasites, particularly ascarids, in swine; why *Hypoderma* species fail to propagate after introduction in the larval stage; and the status of the true tick on Alaskan farm animals.

FUR-FARMING PROBLEMS AND PROPOSED RESEARCH

Fur farming in Alaska is an important activity which seems to offer possibilities for considerable expansion. It is a type of farming suitable either as full-time employment or as a supplementary activity to other agricultural operations, such as dairying. Furthermore, there are many material advantages in Alaska for this type of farming. Much of the feed for the animals is available locally from the extensive fish industry, which saves the high cost of imported materials. Conditions of soil fertility, permafrost, and low temperatures, so vital in some other types of farming, are of minor consequence here. Perhaps most important of all in an expanded agricultural program, the product is so light in weight that it can be shipped out of the country economically.

The Bureau of Animal Industry of the Department is now cooperating with the Alaska Experiment Station at Petersburg in a research program on fur-bearing animals. This program should be extended, particularly on problems of feeds and feeding, as the fur-farming industry of Alaska expands.

AGRICULTURAL-ENGINEERING PROBLEMS AND PROPOSED RESEARCH

LAND CLEARING

Clearing his land is the most costly item the new settler has to meet in developing an economic farm unit. Most of the old farms also need more land cleared for the production of home-grown feed for livestock. Some of the most important decisions to be made are between power and other methods of brush, tree, and stump removal, between direct and delayed clearing, considering costs and results, and whether to utilize timber for lumber, boxwood, or firewood.

FARM BUILDINGS

The extreme climatic conditions in Alaska are the cause of many housing problems not common to most of the continental United States. Some of the more important are (1) orientation of buildings—exposure to sun, wind, and snow; (2) settling and heaving of foundations—detection of ice blocks, insulation to avoid thawing of permafrost; (3) use of local material—cutting, seasoning, and use of local timber, testing and use of concrete aggregates, collection, drying, and installation of sphagnum moss and other local insulating materials; (4) farmhouses—relation to other buildings, space requirements, food-storage requirement, insulation, heating, and lighting; (5) dairy buildings—pen vs. stanchion barn, ventilation, control of floor temperatures, exercise yards, lay-out and equipment for efficient operation; (6) poultry housing—temperature control, wet litter, ventilation, labor-saving arrangement and devices; (7) potato and vegetable storage—temperature and humidity control, shell cooling or heating, earth-covered vs. insulated storage, operating methods, and box handling; (8) silos—comparison of upright and covered-trench silos, construction, upkeep, and labor costs, freezing and spoilage of silage; (9) greenhouse construction and heating—use of insulation; (10) natural cold-storage chambers—temperature control, convenience of operation; (11) water supply—sources, storage, purification, pumping and distribution; and (12) waste disposal—household, dairy barn, and milk house.

FARM MACHINERY

The season for operating field equipment is very short in Alaska. Farming is in competition for labor with mining, fishing, road construction, transportation, and servicing of military installations during the period of greatest activity on the farm. Some of the more important needs are for mechanization of truck-crop production in a manner similar to that of sugar-beet production, and improved potato harvesting methods, including mechanized harvesting and reduction of mechanical injury.

CROP AND PRODUCT DRYING AND HANDLING

Need for feed reserves for winter feeding and for poor crop years is the most important limiting factor in livestock production in Alaska at the present time. Artificial drying of hay is one of the most promising developments for providing off-season high-quality forage. Problems needing attention are mow-dried vs. field-cured vs. ensiled hay and forage crops, and drying of moss and native grasses for bedding and insulation.

FARM USE OF ELECTRICITY

Some important problems concerned with the use of electricity are (1) effects of lighting on poultry and livestock; (2) bactericidal lamps; (3) sun lamps; (4) chick and pig brooders; (5) soil heating, hotbeds, and greenhouses; (6) home lighting and power for household equipment, and (7) power for farm equipment and small industries.

The engineering program is based on the assumption that, as a commodity or activity in the general program is selected for study, all segments or sciences concerned will be included in the ratio of their importance. Thus the detailed engineering requirements will be based on the scope of the over-all program that may be undertaken.

ENTOMOLOGICAL PROBLEMS AND PROPOSED RESEARCH

The following summary of information on insect pests of crops, forests, livestock, and man is based on information gained during the late summer of 1946, under funds provided for research on insects affecting man and animals, with some provision for travel funds to enable contact to be made between the entomologists already in Alaska and the task force. Much information on insect enemies of cereal, forage, and truck crops has been gained through the work carried out cooperatively by the Alaska Experiment Station and the Bureau of Entomology and Plant Quarantine during 1943, 1944, and 1945. This work was largely financed by the Alaska Experiment Station and was done by a Bureau of Entomology and Plant Quarantine specialist, who was loaned to the experiment station during the summer seasons involved.[1] Additional information on insect problems in Alaska was obtained by Bureau of Entomology and Plant Quarantine entomologists who worked on the reindeer warble problem at Nome and on the mosquito problem in the mining area at Fairbanks several years ago.

INSECT PESTS OF VEGETABLE CROPS

Root maggots of several species are the most important vegetable-crop pests with which the Alaskan farmer has to contend. Root maggots occur in damaging numbers each year on cole crops such as cabbage, cauliflower, rutabagas, turnips, and radishes. The most important species is the turnip maggot, which infests nearly all plants of the mustard family. The seed-corn maggot, second in importance, is a more general feeder than the turnip maggot and is destructive to germinating seedlings of many types of plants. Under some conditions it affects the leafy top growth or bud growth of spinach. Since the cole crops are naturally adapted to Alaskan climatic conditions, these root maggots are of exceptional importance in the economics of vegetable production in Alaska.

Cutworms of several species are abundant and destructive on various garden crops in the Matanuska Valley and presumably in other areas where farm operations are undertaken. Flea beetles on potatoes and several other insects on various crops are of minor importance but may cause considerable damage occasionally. Pests of berry crops have not been investigated.

CEREAL AND FORAGE CROP PESTS

Spring oats, barley, wheat, Canadian peas, and a few grass and legume crops are basic to dairying, poultry raising, and general farming in Alaska. Cutworms cause considerable damage to these crops.

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[1] Published in 1949: CHAMBERLIN, J. C. INSECTS OF AGRICULTURAL AND HOUSEHOLD IMPORTANCE IN ALASKA, WITH SUGGESTIONS FOR THEIR CONTROL. Alaska Agr. Expt. Sta. Cir. 9, 59 pp., illus.

Research on truck-crop and forage-crop insects has indicated some possible lines of attack, but these have not been satisfactorily tested and at best are inadequate to meet the situation.

FOREST INSECTS

Very little information has been collected on the forest-insect situation in the national forests in Alaska. From time to time, since about 1915, reports of serious insect outbreaks in spruce, hemlock, and Douglas fir have come to our attention.

Rather heavy losses have occurred in the spruce forests from the attack of the spruce bark beetle, *Dendroctonus* sp. Extensive areas of hemlock have been killed by the hemlock looper, *Ellopia* sp. Outbreaks of the black-headed budworm, *Peronia*, and sawflies on Douglas fir have also been reported and examined.

During the summer of 1946 a destructive outbreak of the spruce bark beetle was observed. This outbreak has been progressing for 2 years and most of the timber in the affected area has been destroyed.

INSECTS AFFECTING MAN AND ANIMALS

Insects are a serious pest of man and animals throughout Alaska. Mosquitoes, blackflies, and sand flies not only impede farming operations but affect those engaged in mining, lumbering, fishing, and the resort business. Tourists, highway and railroad construction workers, and military establishments are greatly affected by insect pests. These insects are also troublesome to all classes of livestock, including fur-bearing animals and reindeer. It is thus necessary to find effective methods of controlling them if the resources of Alaska are to be properly developed. Preliminary work indicates that the mosquitoes breed over large areas, but with the development of such highly effective insecticides as DDT it may be possible to reduce greatly the mosquito populations and thus give protection to a whole agricultural community.

PROPOSED RESEARCH

A careful survey of forest insects is needed to determine the extent and aggressiveness of infestation in order to make recommendations as to whether the area should be logged and the merchantable spruce salvaged. Systematic surveys of all susceptible timber types should be carried out every 2 or 3 years in order to detect and possibly prevent serious losses. Methods of handling logs to avoid ambrosia beetle damage should receive some consideration.

Lines of research on insects affecting man and animals should include ground and aerial application of insecticides to destroy mosquito larvae as they hatch, to apply larvicides, and to destroy the swarms of mosquitoes after they have emerged. The use of various types of sprayers, including thermal aerosol machines, may have a place in the program. Studies of repellent mixtures, especially for the protection of livestock, and of methods of treating streams for the destruction of blackfly and sand-fly larvae are needed.

It is proposed to carry on these investigations, especially those involving the use of large equipment such as airplanes, in cooperation with the Civil Aeronautics Authority and the Army. Some of the equipment and other facilities may also be applicable to the investigational work on truck-crop, forage-crop, and forest insects.

FAMILY LIVING PROBLEMS AND PROPOSED RESEARCH

LIVING PROBLEMS

Improving living conditions and helping families to learn how to live in Alaska are basic to the solution of the problem of maintaining a sufficient number of families in that American outpost and of developing its economic resources. The high cost of living there increases the danger of inadequate diets, insufficient clothing, and unsuitable housing. These conditions in turn make for dissatisfied families.

A research program looking toward the improvement of family situations in Alaska should begin with a study of present conditions and practices which affect family living. This should include surveys of food consumption from which the nutritive value of family diets can be computed and their adequacy evaluated. The cost of food should be studied and factors affecting food use analyzed. Similar surveys of the use of clothing and other goods and services and of housing facilities should be made.

On the basis of these surveys, recommendations for immediate improvement of living conditions could be made, and areas of family living that deserve more intensive investigation would be revealed. Then laboratory and other field studies could be conducted to develop better types and kinds of clothing, housing, and household equipment especially suited to satisfactory living under the climatic and economic conditions of Alaska.

Research on the nutritive value of foods produced in Alaska is also needed in order to determine the possibility of improving diets there with home-grown products. Such studies, combined with investigations of the nutritional status of the population, would provide data basic to the nutrition program contemplated. Beginning in the fiscal year 1950, if facilities are available in Alaska the laboratory studies would be carried on there. Until that time they would be conducted at Beltsville.

SIGNIFICANCE OF FAMILY LIVING PROBLEMS

Educational and planning programs concerned with better living are most effective if based on knowledge of actual living conditions. No studies have been made of the eating habits of rural families in Alaska or of the problems of rural families there as they relate to adequate food, housing, and clothing. Facts about rural living in the United States contribute little to an understanding of the situation in Alaska. All reports strengthen the belief that housing there is inadequate in many respects and that, throughout many months of the year, diets are far from adequate. There seems little doubt that families need increased assistance in adapting themselves to the environment found there—an environment very different from that to which most of them have previously been accustomed.

The information secured from a study of family consumption and expenditures would be of immediate use to the Department of Agriculture in planning programs for the development of the agricultural resources of Alaska. It would also be valuable as the basis of educational material, which would reach the people through the Extension Service and other channels.

PROPOSED RESEARCH

Surveys will be made of food consumption at various seasons of the year, so that the adequacy of diets can be appraised and recommendations made for improvement. Information will be obtained on the amount and kind of family furnished food, including that preserved and stored, and on factors governing the amount and nature of the supply. Surveys will be made of housing conditions and facilities, of family needs and preferences for housing, of the kind and quality of clothing and household textiles needed and obtained annually and prices paid, and of other aspects of consumption. These studies will focus on data useful in helping families to adapt themselves to their environment.

FARM-MANAGEMENT PROBLEMS AND PROPOSED RESEARCH

FARM PROBLEMS

Settlers have been engaged in farming in the Fairbanks and Palmer areas for a number of years. An analysis of their experience and the organization of their farms and farming practices and an interpretation of experimental results at Fairbanks are needed in order to determine the opportunities for increasing farm production in Alaska, the physical and financial returns from farming that may be expected by prospective settlers on various soils and in various situations, and the farm organization and farming practices which will increase farm income to the maximum.

MARKET PROBLEMS

Although physical production potentialities are yet to be determined, it appears that the output of farm products in Alaska could be greatly increased. Market outlets constitute a principal limiting factor. Investigations are needed to indicate for both immediate and long-run periods (1) the size and character of local market demand for farm commodities in Alaska; (2) potential demand in the United States and Canada for agricultural products which could be economically produced in Alaska; (3) prospective export outlets in other countries; (4) local assembling, transportation, and distributing facilities needed for servicing Alaskan producers and consumers; (5) processing and other facilities, such as for frozen foods, required for meeting local seasonal food requirements and for taking advantage of other market opportunities; (6) transportation facilities, such as air transport, needed to develop outside markets; and (7) the prices that are likely to be realized by farmers for different kinds of farm products.

SIGNIFICANCE OF MANAGEMENT PROBLEMS

There is an immediate need for an adequate appraisal from the farm management point of view, of farming opportunities in Alaska. Veterans and others are investing both their savings and their future in farming in Alaska without anything approaching an adequate appraisal of their farm income expectancies. Recent developments presaging statehood for Alaska, and the current consideration being given to the release of additional land for homesteading, indicate an accelerated development of farming in Alaska and an ever greater need for the best guidance possible.

PROPOSED RESEARCH

The work to be undertaken would be confined to the Fairbanks and Palmer areas, which offer the best practical source of farm management information as well as some of the better prospects for new settlement. Information would be obtained on actual farming experience on various soils. This would include information obtained from farmers on their crop and livestock systems, crop yields and rates of livestock production, farming practices, production expenses, gross income from farming and other sources, and farm capital requirements. It would be organized so as to provide an adequate sample of farming experience in the areas studied. Experimental results at Fairbanks would be assembled and interpreted in light of the information obtained on actual farm experience and that available from soil analyses, so as to provide an analysis of farming potentialities. Farm budget analyses would be developed for a number of representative farms in order to show for the various farming situations the cost of production and relative returns from the major enterprises and desirable alternative combinations of enterprises. This work would be undertaken in close cooperation with companion studies of soils. The results would be made available to prospective settlers, Alaskan farmers, and other persons connected with Alaskan agriculture.

FACTORS INVOLVED IN COST OF PROPOSED PROGRAM

The cost of conducting a research program in Alaska is high compared to costs for similar research in the United States. Wages for labor and technical assistance are almost double that of similar assistance in the United States. Equipment and supplies are practically double what they would be in the United States, or if purchased in the States the shipping cost will add greatly to the total expenditure. Living costs for personnel are so high that higher grade consideration may be necessary in addition to the 25-percent differential, to interest qualified professional staff to accept assignment for work in Alaska. Travel costs are high and the areas to be studied extensive and scattered. It will be highly desirable to provide for biennial trips to the outside for professional staff for subject-matter contacts because of the extreme isolation of the Territory. Department project leaders and subject-matter specialists in the States who are cooperating on joint projects should be given opportunity to study their problems on the ground in the Territory.

It is recommended that the fields of work to be undertaken first include research on soil classification, mapping, and management requirements; breeding of improved and adapted varieties of field crops; livestock and dairy cattle breeding, feeding, and management; fur farming; agricultural engineering, including land clearing, farm buildings, farm machinery, feed handling and drying, and farm use of electricity; insect pests; and farm management. After this work gets under way, research could be started on animal, plant, and human nutrition, vegetable and small fruit breeding, marketing and other phases of agricultural economics, livestock diseases, and forest diseases.

The estimated cost of the proposed program for the first year is $150,000, and it is recommended that the program be developed over a 5-year period to one which would cost three or four times that amount annually. This would be in addition to expenditures by the Territory.

Physical plant facilities for conducting research in Alaska are very limited. The Alaska Experiment Station, Territorial Department of Agriculture, Alaska Rural Rehabilitation Corporation, Matanuska Valley Farmers' Coop., various Federal agencies operating in Alaska, and farmers will probably be able to provide the necessary housing during the first two years, while the program is being organized and preliminary studies initiated. The program will be planned to cooperate with existing agencies that can contribute facilities, etc., in order to do the most effective and economical job. Because of the high cost of construction in Alaska, the estimates for essential facilities, offices, laboratories, greenhouses, barns, shops, etc., during a 5-year development period, will approximate $500,000 or more. This cost would be in addition to operating costs of the research program, and it is believed that some of the necessary facilities would be provided by cooperators.

Report on Exploratory Investigations of Agricultural Problems of Alaska

Chapter 2. Soils of Alaska

By Charles E. Kellog, *chief*, and I. J. Nygard, *soil scientist, Division of Soil Survey, Bureau of Plant Industry, Soils, and Agricultural Engineering*

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GENERAL SETTING

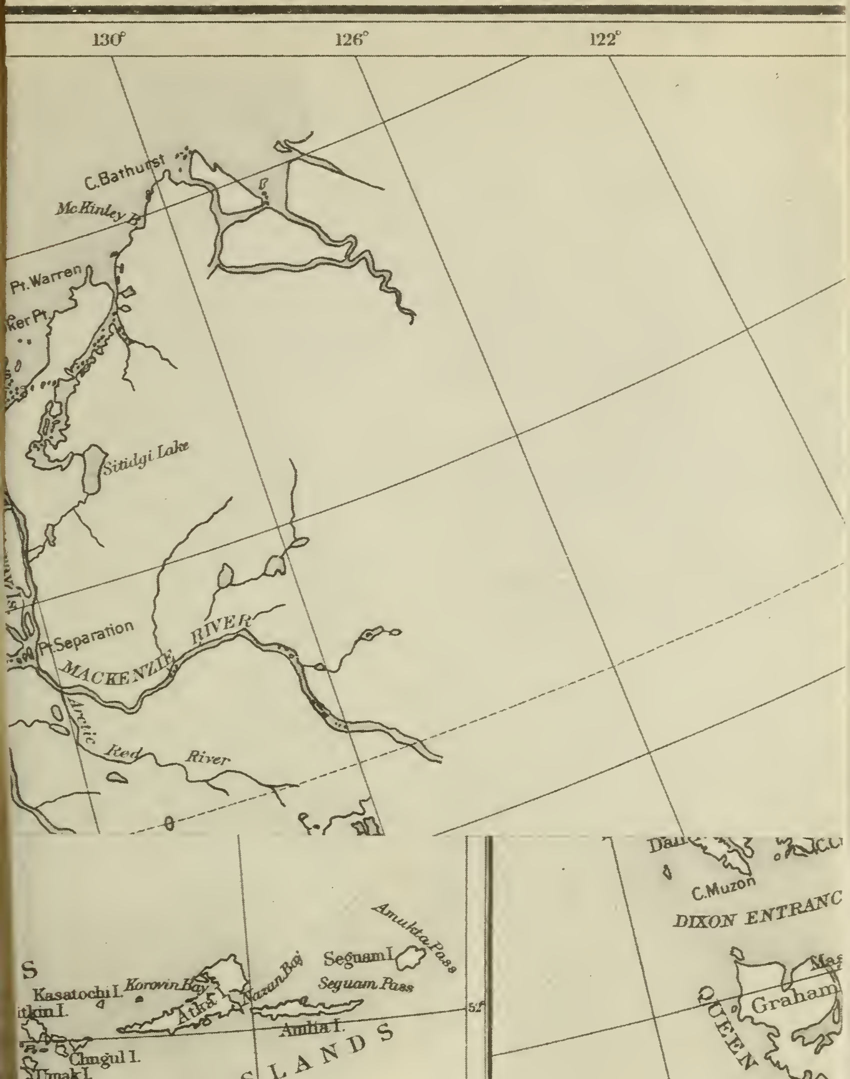
Alaska is a vast region and a land of contrasts. Its total area of 586,400 square miles, or 375,296,000 acres, is roughly equivalent to one-fifth the area of continental United States. Unlike our mainland, this area is not a compact block, but consists rather of a large central body with two long arms, one formed by southeastern Alaska, the other by the Alaska Peninsula, from which the Aleutian Islands extend as a thin chain into the Eastern Hemisphere. With its many other peninsulas and islands, the total reach of the Territory is almost equal to that of our mainland (fig. 1).

Alaska has many kinds of soil. In such a vast area are many different combinations of climate, vegetation, parent rock, relief, and age of landscape. Each significant combination of these five factors has its own unique soil.

The greater part of Alaska consists of high jagged mountains, many of which are covered with snow even during summer; high plateaus, tundra plains, swampy stream valleys, coarse gravelly and cobbly plains and slopes, and other landscapes where either soil or climate, or both, are unsuitable for any kind of crop production (fig. 2). In some of these areas, fair to good range could be had for perhaps 3 to 4 months of the year, but such ranges are not associated with land suitable for growing the feed crops necessary in the long winter period. Even though the soil areas where agriculture can be carried on are small and scattered, they are important—important in themselves and more especially for the full use of other resources.

In some important respects, similarities exist between the soils of Alaska and those of the northern Lake States—the northern parts of Minnesota, Wisconsin, and Michigan. The results of farm experience and of agricultural research in the northern Lake States are of great value to an understanding of the basic agricultural conditions in Alaska. Several of the soil problems in Alaska, however, are unknown in the Lake States.

Alaska is a subarctic region, like the northern parts of Canada, Scandinavia, and the Soviet Union. Problems of the subarctic will need to be studied and solved there—not in the mainland of the United States. For example, many of the soils are permanently frozen at depths of a few inches or a few feet beneath the surface. Practically all the soils, whether frozen or not, are too cold for root growth at depths of a foot or two below the surface. Yet even though the growing season is short, in summer daylight is almost continuous. Then plants grow fast.



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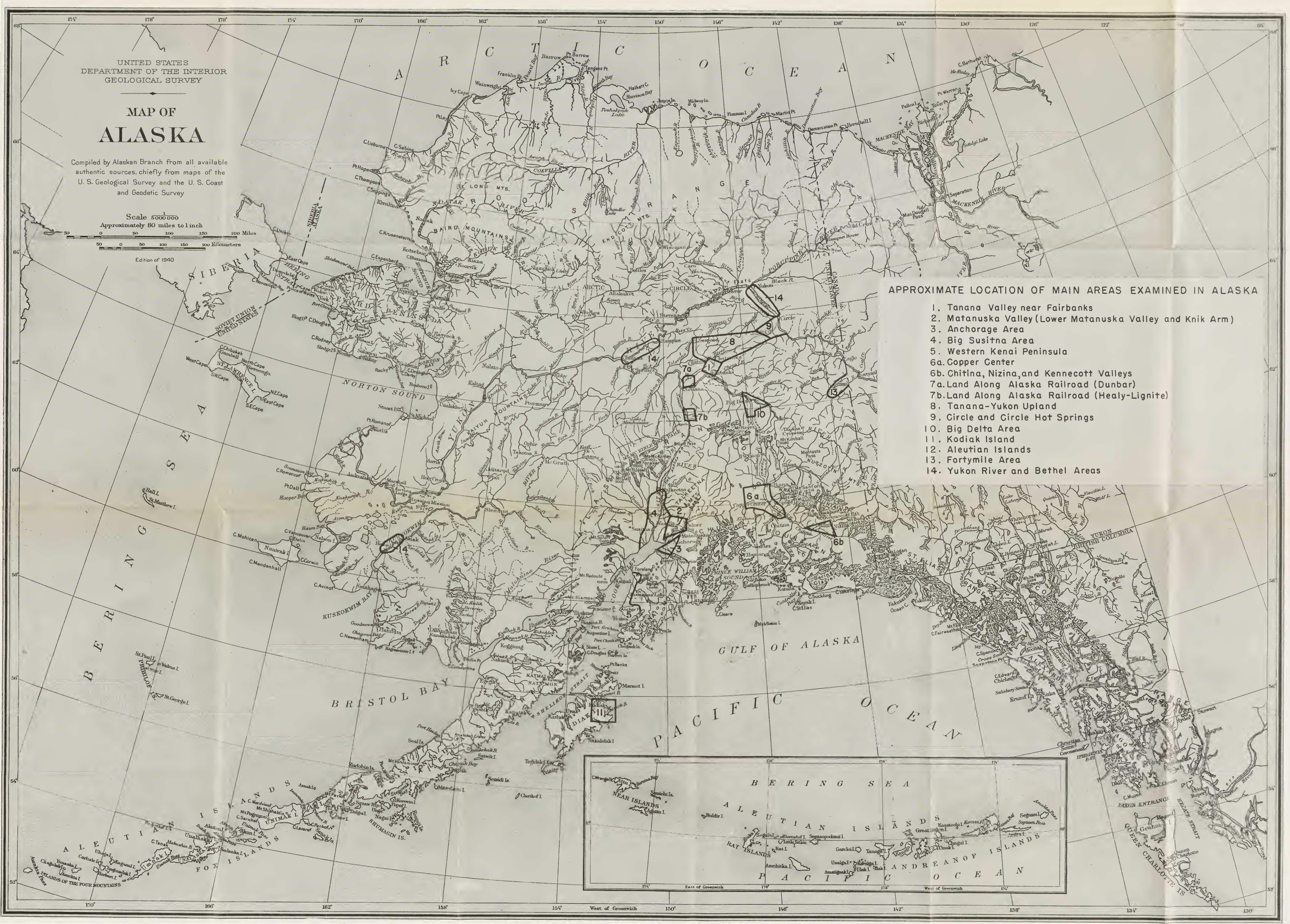
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
MAP OF
ALASKA
Compiled by Alaskan Branch from all available authentic sources, chiefly from maps of the U. S. Geological Survey and the U. S. Coast and Geodetic Survey
Scale 1/5000000
Approximately 80 miles to 1 inch
50 0 50 100 150 200 Miles
50 0 50 100 150 200 Kilometers
Edition of 1940
APPROXIMATE LOCATION OF MAIN AREAS EXAMINED IN ALASKA
1. Tanana Valley near Fairbanks
2. Matanuska Valley (Lower Matanuska Valley and Knik Arm)
3. Anchorage Area
4. Big Susitna Area
5. Western Kenai Peninsula
6a. Copper Center
6b. Chitina, Nizina, and Kennecott Valleys
7a. Land Along Alaska Railroad (Dunbar)
7b. Land Along Alaska Railroad (Healy-Lignite)
8. Tanana-Yukon Upland
9. Circle and Circle Hot Springs
10. Big Delta Area
11. Kodiak Island
12. Aleutian Islands
13. Fortymile Area
14. Yukon River and Bethel Areas
ARCTIC OCEAN
BERING SEA
NORTON SOUND
BRISTOL BAY
GULF OF ALASKA
PACIFIC OCEAN
SIBERIA
SEWARD PENINSULA
BROOKS RANGE
ALEUTIAN ISLANDS
FOX ISLANDS
ISLANDS OF THE FOUR MOUNTAINS
ANDREANOF ISLANDS
RAT ISLANDS
NEAR ISLANDS
SHUMAGIN IS.
PRIBILOF IS.
KUSKOKWIM BAY
PRINCE WILLIAM SOUND
DIXON ENTRANCE
HECATE STRAIT
QUEEN CHARLOTTE IS.
BRITISH COLUMBIA
YUKON
MACKENZIE RIVER
West of Greenwich
East of Greenwich
1
2
3
4
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6b
7a
7b
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FIGURE 1. Approximate Location of Main Areas of Agricultural Interests in Alaska.

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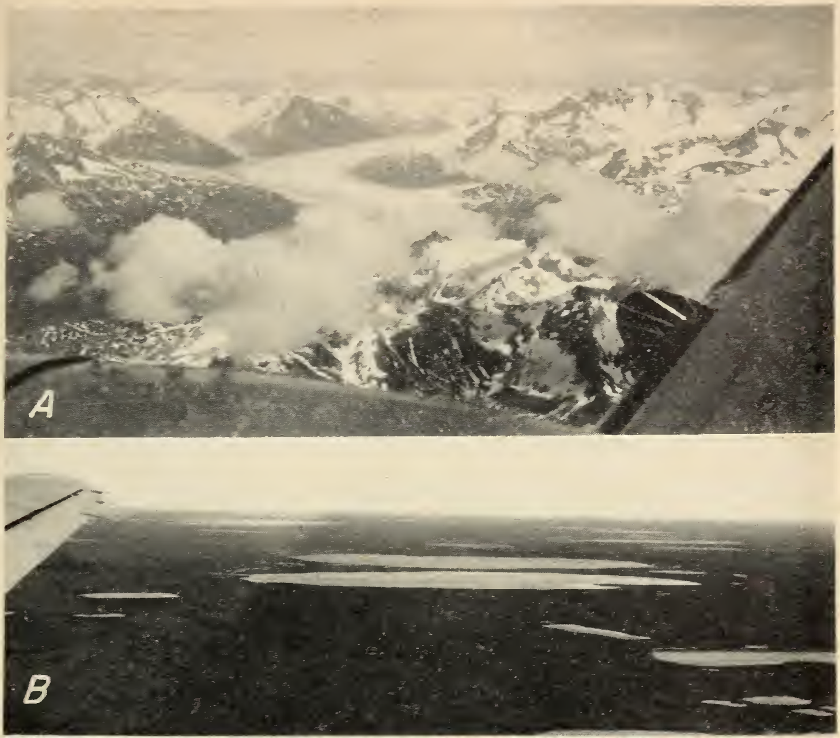

Figure 2.—Alaska has many landscapes where soil or climate or both are unsuitable for any kind of crop production. *A*, Snow-capped mountains and glaciers about 75 miles northwest of Juneau. *B*, The tundra south of Point Barrow is dotted with ponds and has permanently frozen subsoil. *C*, Mosses, sedges, and dwarf birch cover part of this thin stony soil, where crops will not grow.

AGRICULTURAL POTENTIALITIES

The areas with agricultural possibilities in Alaska are now generally known (fig. 3). Despite disagreement and uncertainty about the exact acreage suitable for cropping, it is generally agreed that at least 95 percent of the soil is unsuitable for agricultural use.[1]

The potential farm land is confined to a few scattered localities, most of which are small. The good soils are largely young soils developed from stream alluvium or from stream alluvium covered with windblown very fine sand. In some agricultural communities—especially in the Matanuska Valley and near Fairbanks—many successful farms have been in operation for several years. The families on these farms have learned a good deal about the potentialities of their land and they understand the advantages and handicaps of farming in the Territory.

The exploratory party visited most of the potential agricultural areas, including those regarded by some as potentially suitable for farm use. These were the Tanana Valley around Fairbanks, the Tanana-Yukon Upland, the area around Circle and Circle Hot Springs, the Big Delta area, the Matanuska Valley near Palmer, the Homer area, the farming and suburban area around Anchorage, the lands along the Alaska Railroad, the Copper River Basin, Kodiak Island, and part of the Aleutian Islands.

PREVIOUS ESTIMATES OF ARABLE LAND

One often sees the estimates of the late C. C. Georgeson quoted in articles about agricultural possibilities in Alaska. He was in charge of the Alaska agricultural experiment stations from their establishment until 1928 and had opportunity for extensive travel in the Territory. He saw hardy vegetables growing luxuriantly and became so enthusiastic about farm possibilities that he was led to arrive at high estimates of agricultural land. He suggested that about 41,000,600 acres (65,000 square miles) could be tilled and that an additional

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[1] Many previous investigations of land in Alaska have been made. The U. S. Geological Survey, for example, has been studying and reporting on mineral resources and land features in the Territory for some 45 years. Reconnaissance soil surveys were made by the Department of Agriculture in 1914 and 1916. More recently the Soil Conservation Service of the Department has published studies of the Matanuska Valley. In addition, there have been a great many other botanical and agricultural studies of one sort or another. Of the many reviewed, the more helpful ones are given in the list of references, p. 85.

Helpful suggestions were received by the exploratory party through conversations with many persons. In addition to resident farmers, who were very cooperative and helpful, the following should be mentioned:

John C. Reed, staff scientist, Territories and Island Possessions, U. S. Geological Survey.

Robert Coote, Bureau of Land Management, U. S. Department of the Interior.

Joseph Flackney, Director of Alaska Territories, U. S. Department of the Interior.

Meridith F. Burrill, Director, U. S. Board on Geographical Names, U. S. Department of the Interior.

G. A. Gasser, Commissioner of Agriculture of the Territory of Alaska, Fairbanks, Alaska.

Don L. Irwin, General Manager, Alaska Rural Rehabilitation Corporation, Palmer, Alaska.

Lorin T. Oldroyd, Director of Agricultural Experiment Stations and Extension Service, University of Alaska, Fairbanks, Alaska.

Barney Travicky and Capt. Homer Humphrey, Permafrost Laboratory, U. S. Army Engineers, Ladd Field, Fairbanks, Alaska.

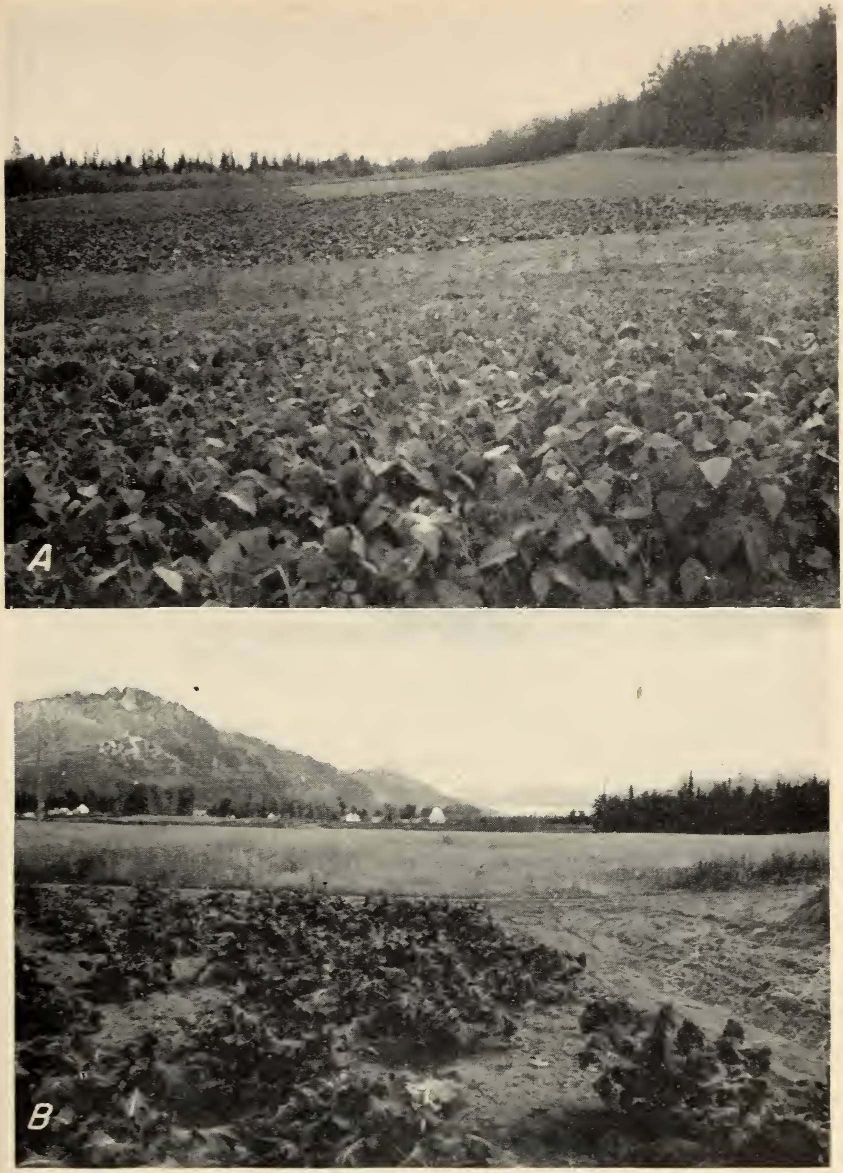

Figure 3.—Soil areas in Alaska with agricultural possibilities are now generally known. *A*, Vegetable garden in the Tanana Valley north of Fairbanks, on Fairbanks very fine sandy loam with a gentle south-facing slope. *B*, Farm in the Matanuska Valley northeast of Palmer, on Bodenburg very fine sandy loam, one of the best soil types for agricultural use in the valley. Vegetables and wheat are shown growing in the foreground, with the Knik glacier as a backdrop.

22,400,000 acres (35,000 square miles) could be pastured. These figures were quoted as authoritative as late as 1940 (*25*)[2] and, indeed, are still being quoted (*18*).

Although Dr. Georgeson's estimates are now regarded as considerably beyond the maximum acreage suitable for agricultural development, they did serve an important purpose: They dispelled the old popular misconception that Alaska is entirely a forbidding land of ice and snow.

These figures remained the only ones available until recently, when they were challenged by several who have had opportunities for extensive travel in Alaska and for study of its agriculture. In an interview, Robert Coote, of the Bureau of Land Management, United States Department of the Interior, expressed the opinion that these often-quoted figures are too high, although he gave no definite lower estimate. Rockie, in a report entitled "What of Alaska" (*23*), estimated some 2,870,000 acres (4,485 square miles) as available for crop production and 4,228,000 acres (6,606 square miles) available for use as range.

SMALL LAND AREA SUITABLE FOR FARMING

Although it is important to recognize that good agricultural land exists in Alaska, it needs to be emphasized that the total area is indeed small, probably much smaller than many of the estimates currently published.

During the exploratory investigations of the soils in the summer of 1946, it was possible to make some estimates of the potential farm land in part of the areas where previous estimates had been made by others. It appeared to members of the party that all the previous estimates of the acreage of arable land were high. Included in some of these previous estimates were soils similar to some in the northern Lake States which are considered unsuitable for crop use and are not farmed. Economic conditions, of course, are not the same in the two places. Soils in Alaska that are closely associated with sources of nonfarm employment and are near an active local market, such as those near Anchorage, might well be used for crops.

Although the exploratory party can by no means give an accurate final figure, it seems entirely reasonable to suggest that the total area of land suitable for crops, under anything like present economic conditions, is considerably less than 1,000,000 acres for the whole Territory. Many of these acres are intermingled with others not suited to crops.

Although perhaps high, Rockie's estimate of potential range land may be said to be reasonable in terms of summer pastures alone. But since winter feed supplies are necessary in order to use summer pasture, from a practical standpoint the actual area of range land that could be economically used in range and farming systems is only a small fraction of Rockie's estimate of some 4,000,000 acres.

AREAS OF AGRICULTURAL INTEREST

In the areas of primary concern, representative soils were carefully examined in relation to the geological material, native vegetation, and present agricultural use. The purpose was one of assessing research needs and defining the major problems and potentialities. Time was too short, of course, for obtaining data complete enough for giving final judgments on either the acreage of good soil available or the best systems of farming to follow. Considerable research will be necessary to learn what can be done with some soils. The best source of information now is the experience of established farmers. Great uncertainty exists about kinds of soils that have not been farmed to any significant extent.

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[2] Italic numbers in parentheses refer to List of References, p. 85.

The principal areas according to present knowledge and conditions are the Tanana Valley near Fairbanks and the Matanuska Valley near Palmer. Of next importance are the part-time farming and suburban area near Anchorage and the Homer area on the Kenai Peninsula. In addition are many other less known and smaller areas, besides tiny spots throughout great parts of the Territory suitable for small gardens and individual farms or ranches.

Though each has a unique association of soils, the areas referred to here should be regarded as convenient geographic units rather than strictly defined soil associations. The names by which the areas are generally known and which are used on the map (fig. 1) are the following:

Tanana Valley near Fairbanks.
Matanuska Valley (Lower Matanuska Valley and Knik Arm).
Anchorage area.
Big Susitna area.
Western Kenai Peninsula.
Copper River Basin:
  (*a*) Copper Center area.
  (*b*) Chitina, Nizina, and Kennecott Valleys.
Land along Alaska Railroad.
Tanana-Yukon Upland.
Circle and Circle Hot Springs area.
Big Delta area.
Kodiak Island.
Aleutian Islands.
Fortymile area.
Yukon River and Bethel areas.
Miscellaneous areas for subsistence crops.

TANANA VALLEY NEAR FAIRBANKS

Although only a few thousand acres have been cleared for crops and pasture, this is a promising agricultural area. Farming is the main source of living for relatively few families, say 30 to 50, but the possibilities for success have been well demonstrated. Reasonably large areas of soil could be used for more farms, if local roads were built and if the land could be obtained at reasonable cost.

Fairbanks is the important trading and communication center for the whole central part of Alaska.

Physiography.—The main farming area lies northwest, north, northeast, and east of Fairbanks, which is situated on the Chena Slough, a channel of the Tanana River. The area has three principal land forms: (1) The wide, nearly level valley floor; (2) the lower valley slopes and low ridges to the north; and (3) a ridge country of rolling upland still farther north and northeast. The last of the three divisions constitutes the southern part of the Tanana-Yukon Upland as well as the upper part of the Tanana Valley. Most of the present farming is on the gently sloping land with southern exposure between these northern uplands and the valley floor.

The underlying country rock is chiefly micaceous schist, with some quartzite schist and metamorphic shale. The valleys have deposits of very fine sandy alluvium. The hills and slopes are covered with a mantle of wind-blown, very fine sand.

Climate.—The summer weather is pleasant, but most Alaskans insist that winter is more enjoyable because there are no mosquitoes and no dust—two unpleasant accompaniments of summer. There is almost no wind, summer or winter. The summer days are warm, like those in central Minnesota, not uncomfortably hot. The July average temperature is 60° F. and the mean for the summer months of June, July, and August is 57°. The average frost-free period for hardy crops extends from about May 20 to about September 5. Winter comes suddenly. The minimum winter temperature on record is −66°. The nearly continuous sunshine in summer accelerates crop growth.

The annual precipitation is about 12 inches, half of it falling during the growing season. This rainfall is usually adequate for the production of crops on most soils in the area, but conservation of moisture is an important aspect of farm practice. Many persons irrigate their gardens.

Vegetation.—The wild land has a rather heavy cover of vegetation. Most plant roots are shallow. Common trees are white spruce, black spruce, balsam poplar (locally called cottonwood), quaking aspen, and white birch (fig. 4). White spruce predominates. Both burning, which is common on valley slopes and lower ridges, and good drainage favor white birch and poplars over spruce. Nearly pure stands of white birch grow on several well-drained slopes and ridges. Black spruce grows on the bottom land, and both black spruce and tamarack on peat. Willows and alder grow along streams and in many swampy places. Native grasses and sedges are found, particularly in such disturbed places as abandoned camp sites and roadways. Most soils have a ground cover of dwarf heath shrubs similar to those found on peat bogs in the Lake States. The most prominent of these are Labrador-tea (*Ledum groenlandicum*), several kinds of blueberries, mountain cranberry (*Vaccinium vitis-idaea*), and crowberry (*Empetrum nigrum*). Fire has significantly modified the wild vegetation in most places except on the wettest soils.

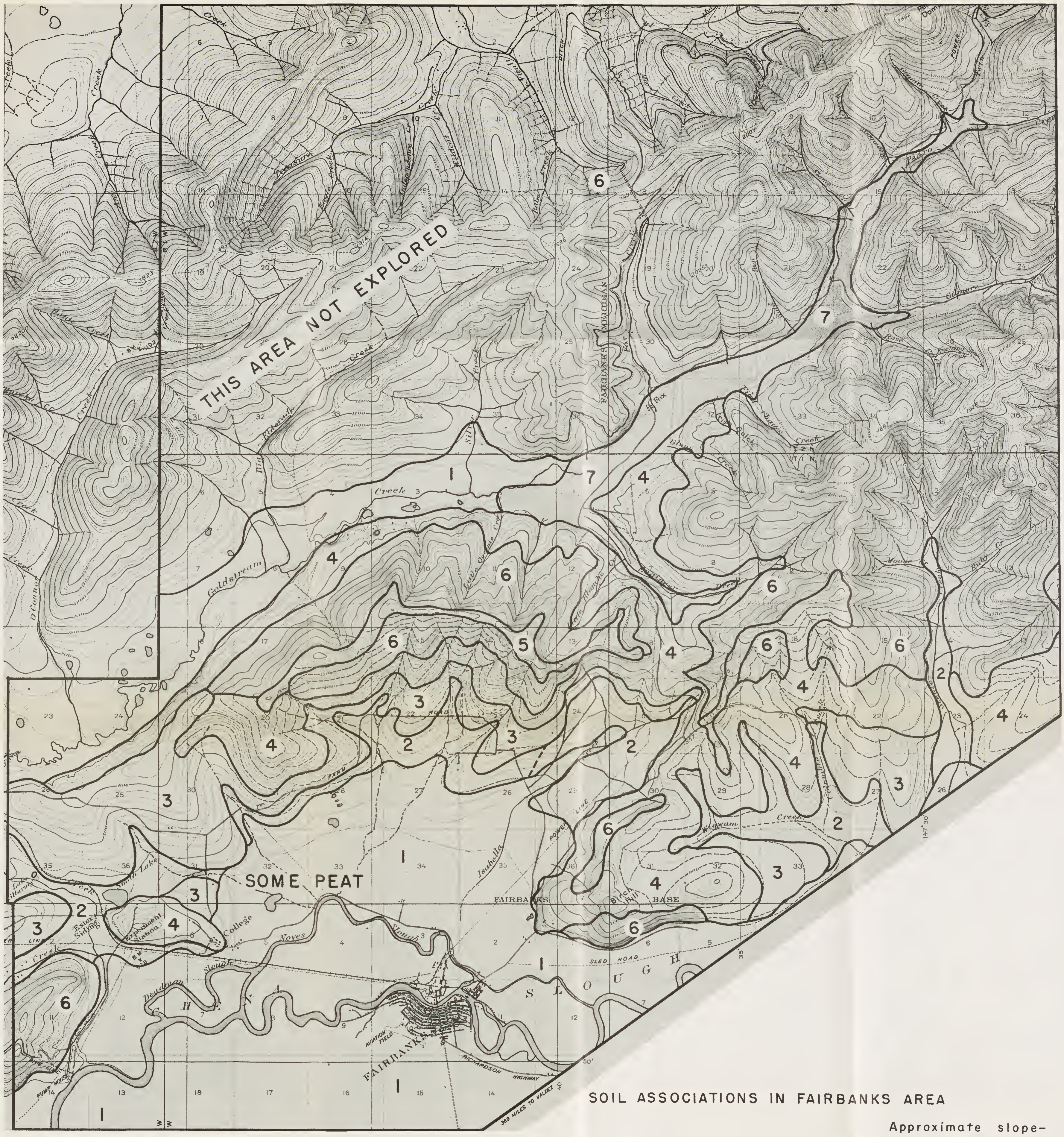
SOILS

The important soils in the area are closely related to the three broad land forms. Tanana soils occupy most of the alluvial bottom lands and low terraces of the wide, nearly level valley floor; Fairbanks soils dominate the lower valley slopes and low ridges (fig. 5); and Gilmore soils are found on the rolling upland. On a generalized soil map (fig. 6) these three broadly defined soil associations are shown, along with a fourth group that includes mainly mine tailings. Descriptions of these associations and of part of the soil units composing them follow.

Tanana Soil Association

In the Tanana soil association the soils are friable, stone-free, moderately well-drained, and nearly nevel; hence they are easy to cultivate after clearing. The surface of uncultivated soils is acid but beneath they are nearly neutral or even slightly alkaline. They have developed

Creek
2200



SOIL ASSOCIATIONS IN FAIRBANKS AREA

	Approximate slope-percent
1. Tanana soil association, nearly level	0-3 percent
2. Tanana (local colluvium) soil association, nearly level to gently sloping	0-5 percent
3. Fairbanks soil association, gently sloping	0-8 percent
4. Fairbanks soil association, sloping	8-15 percent
5. Fairbanks-Gilmore soil association, gently sloping	0-8 percent
6. Fairbanks-Gilmore soil association, strongly sloping	15 + percent
7. Mine tailings	

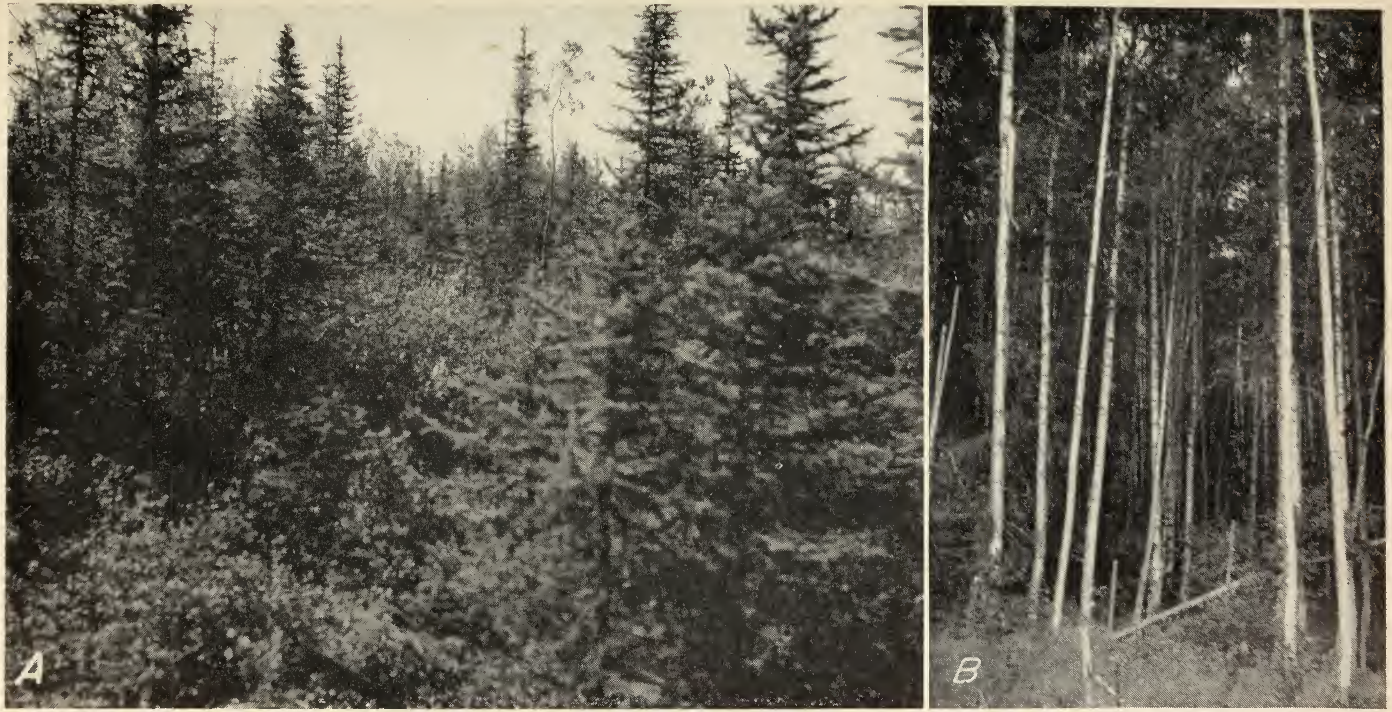


FIGURE 4.—Spruce and white birch furnish much of the tree cover in the Tanana Valley north of Fairbanks. *A*, Spruce trees, both white and black with shallow roots, are common in the valley on Tanana soils. *B*, Virgin stand of white birch northeast of Fairbanks on a better drained soil. These trees were spared from the ax because of lack of roads.

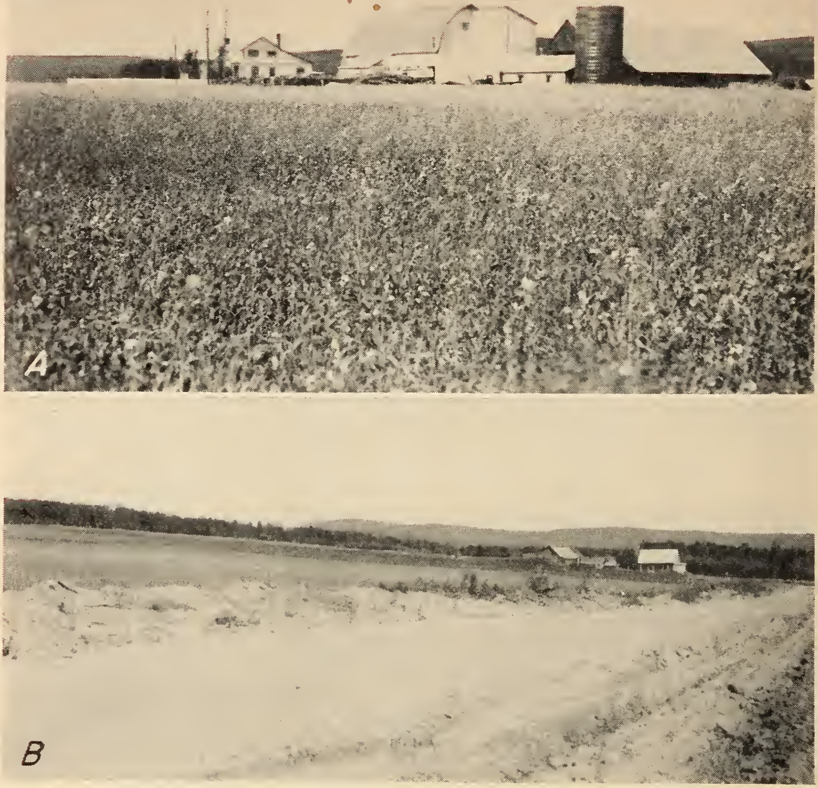


FIGURE 5.—Important soils in the Tanana Valley are closely related to land forms. *A*, Tanana soils have developed on the broad, nearly level floor of the valley north of Fairbanks. This field of oats and peas is on a first-class dairy farm. *B*, Gentle valley slopes on which Fairbanks very fine sandy loam—good farm land—has developed.

from alluvial materials consisting of fine sand, very fine sand, silt, and small flakes of mica in varying proportions. The Tanana soil series dominates the association and, within the series, Tanana very fine sandy loam, although Tanana fine sandy loam and Tanana silt loam are also common soil types.

Tanana Series[3]

The Tanana series includes azonal soils (soils without well-developed profiles) developing from water-sorted sediments derived from sandy materials containing a considerable quantity of mica. They are found on alluvial bottom lands of the Tanana River and a few of its major tributaries under subarctic conditions in central Alaska. Under conditions of restricted drainage above the ever-frozen subsoil (permafrost), organic matter slowly accumulates on the surface and they are developing toward Half Bog soils. Following is a description of Tanana very fine sandy loam under virgin conditions.

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[3] This description of the Tanana soil series is a generalization of five individual descriptions of soil profiles in the Chena Slough and Tanana Valley.

Soil profile

(1) A_{00}. Yellowish-brown to dark yellowish-brown live sphagnum and polytrichum mosses containing leaves of dwarf heath shrubs and cranberries. Raindeer moss often grows among the sphagnum mosses; 2 to 3 inches thick.

(2) A_0. Dark yellowish-brown (sometimes dark-brown) raw moss peat containing tough woody roots and leaves of heath shrubs, spruce needles, and other woody fragments; 2 to 3 inches thick.

(3) A_1. Dusky brown, very fine sandy loam; weak, fine granular structure; high in organic matter; a great concentration of roots; 1 to 2 inches thick.

(4) G_1. Light olive-brown and light olive-gray mottled with weak yellow and moderate brown very fine sandy loam; micaceous; weak fine platy structure; compact in place but very friable when removed; many roots; neutral in reaction; wet and cold; 4 to 6 inches thick.

(5) G_{11}. Mottled light grayish-brown, yellowish-gray and light olive-gray very fine sandy loam, sometimes specked with light yellow brown and moderate brown; micaceous; weak platy structure; compact in place but friable when removed; few roots; mildly alkaline; wet and cold; 5 to 6 inches thick.

(6) C. Yellowish-gray very fine sandy loam, mottled with light yellow brown; micaceous; laminated; friable, mildly to strongly alkaline; wet and cold; 2 to 12 inches thick.

(7) F. Permafrost at 24 to 36 inches.

Range in characteristics.—The A_1 layer may be nearly absent in places. Layers A_{00} and A_0 have often been partially destroyed by fire or land clearing. The permafrost may vary from 12 inches below the surface to 36 inches under native cover and to even greater depths in cultivated fields. Thus the C horizon may be completely frozen in places.

Topography.—The soil is nearly level. Often there is a microrelief of 1 foot or less, with low ridges or mounds and shallow depressions (fig. 7).

Drainage.—Although under the native cover the soils have poor or imperfect drainage, after clearing the permafrost is lowered and the soils become well enough drained for farm crops.

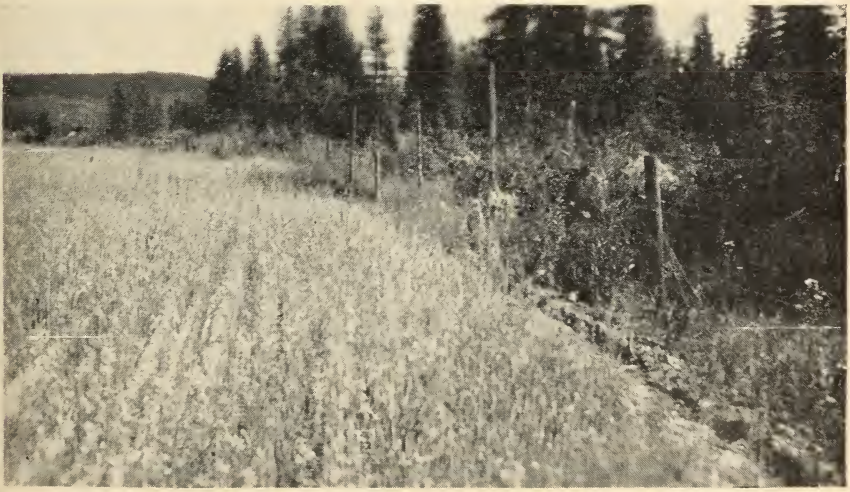

FIGURE 7.—View on a dairy farm northeast of Fairbanks on nearly level Tanana soils. The original native cover of spruce, a few aspens and white birches, and an undergrowth of dwarf shrubs and mosses is shown at the right; the field at the left was cleared and broken and seeded to oats.

Vegetation.—The forest cover consists of a moderate stand of white spruce along with aspen, white birch, and a few black spruces and willows. The underlying ground cover consists chiefly of such plants as Labrador-tea, blueberries, crowberry, and mountain cranberry (fig. 7).

Use.—Little of this soil is used for crops now, although some is used for hay and pasture.

Distribution.—These soils occupy valley floors in central Alaska. They are the predominant soils of the Lower Tanana Valley and Chena Slough near Fairbanks.

Characteristics of Tanana Soils After Cultivation

Where cleared and broken, the mat of fibrous peat is partly destroyed and what remains is mixed with the plowed layer. The plowed soil in cultivated fields of Tanana very fine sandy loam is light gray-brown to dark yellowish-brown, mottled with yellowish-gray and brown friable very fine sandy loam. It breaks readily into weak crumbs or a powdery mass. The subsoil is light grayish-brown and yellowish-brown very fine sandy loam, mottled with brown and yellowish-brown, compact in place but easily friable when removed. In most cultivated fields the permafrost is more than 48 inches below the surface. This lowering of the permafrost has improved the drainage to such an extent that these soils are considered generally well drained for farm crops.

Soil Series Other Than Tanana

In the Tanana soil association are other soil series less suited to cropping than the predominating Tanana soils. These were not investigated in detail.

The Goldstream series is found side by side with the Tanana. It is a mucky silt loam found in lower basins, many of which are settling basins or remnants of old water courses. Beneath a covering of moss, the surface 4 to 12 inches is a dark-brown mucky silt loam, which grades beneath into an olive-gray silt loam, often mottled with brown and yellow brown. At depths of 20 to 30 inches below the surface, the silt loam gives way to a very fine sand high in mica. This soil is nearly level, but it often has a prominent microrelief caused by rounded, compact tussocks of grass some 10 to 15 inches high, locally called “niggerheads” (fig. 8).

Peat soils in the wet areas, commonly called muskeg, constitute an important part of the Tanana soil association. Like the peat of many muskegs in the region it consists mainly of a surface layer of yellowish-brown and reddish-brown raw moss peat, derived largely from sphagnum moss, over dark-brown friable woody and sedge peat at depths of 2 to 3 feet below the surface. Part of a muskeg (northwest of Fairbanks) is described in detail by Dachnowski-Stokes in Peat Resources in Alaska (*11*).

Fairbanks Soil Association

The Fairbanks soil series dominates the Fairbanks soil association. Like the Tanana soils, these are friable and stone-free, but occur on slopes and are better drained. They are found on valley slopes of about 2 to 15 percent gradient on wind-laid deposits of silty very fine sand (fig. 5, *B*).

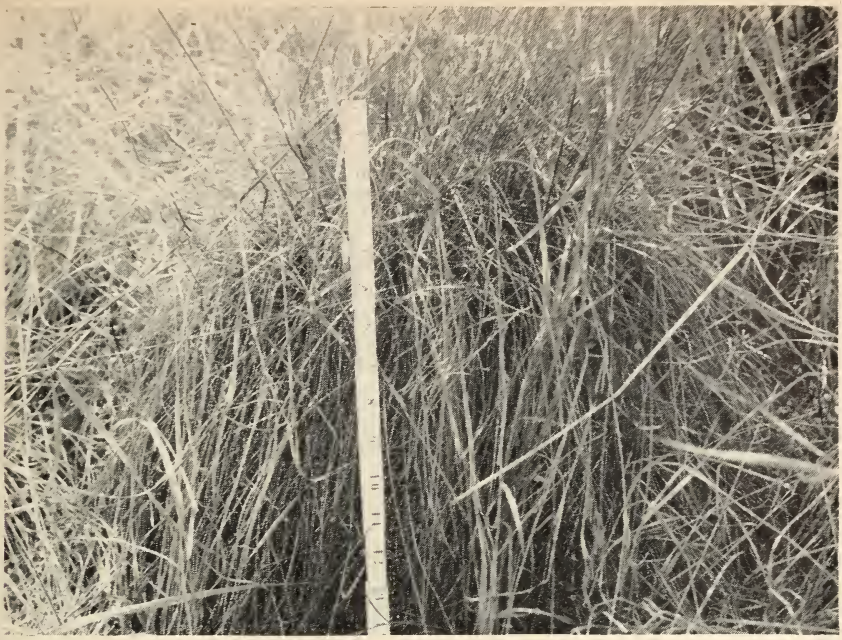

FIGURE 8.—Goldstream soils are nearly level but often have prominent rounded, compact tussocks of grass some 10 to 15 inches high, locally called "niggerheads."

Fairbanks Series

The Fairbanks series includes Brown Forest soils developed from micaceous silty very fine sand on valley slopes and low ridges under the subarctic conditions of central Alaska. Following is a profile description of Fairbanks very fine sandy loam under virgin conditions.

Soil profile

(1) A_{00} and A_0. Dark-brown and weak-brown fibrous organic mat, containing many roots and consisting of leaves, needles, woody twigs, and a few mosses. The lower part is partially disintegrated; 1 to 3 inches thick.

(2) A_1. Dusky-brown to dark yellowish-brown gray very fine sandy loam high in organic matter; irregular granular structure; friable; soft; medium to slightly acid; many live roots and a few worm casts and mycrrhiza mycelium; 1 to 3 inches thick.

(3) A_{11}. Light yellowish-brown to light grayish-brown very fine sandy loam; weak fine platy structure; very friable; soft, slightly vesicular; slightly acid; many live roots; 1 to 3 inches thick.

(4) B_1. Yellowish-brown specked with moderate-brown and strong-brown very fine sandy loam; weak fine platy structure; slightly vesicular; friable; soft; micaceous; compact in place but friable when removed; slightly acid to neutral; many live roots; 3 to 6 inches thick.

(5) B_{11}. Weak yellowish-brown very fine sandy loam; weak fine platy structure; compact in place but friable when removed; few roots; nearly neutral; highly micaceous; 4 to 8 inches thick..

(6) C_1. Weak-yellow very fine sandy loam mottled with yellowish-brown and strong brown; friable, soft; highly micaceous; slightly laminated with a few darker spots between laminations; neutral; 6 to 10 inches thick.

Range in characteristics.—A_{00} and A_0 horizons may be partially destroyed by fire or clearing. The degree of mottling varies in the lower A and in the B horizon. Depth to permafrost varies greatly. In places, no permafrost is found below 5 feet; it sometimes is found at depths of less than 2 feet but often not within 5 feet.

Topography.—Valley slopes and low ridges of 2 to 15 percent gradient.

Drainage.—Surface, good; internal, moderately good to imperfect.

Vegetation.—Generally a heavy stand of tall white spruce, white birch, and balsam poplar. Often there is a tall shrub stratum consisting chiefly of willow, highbush cranberry, wild rose, and sometimes alder. The ground cover consists of dwarf heath shrubs and mountain cranberry, a few mosses, dwarf dogwood, horsetail (*Equisetum*), and bluegrass (*Poa glauca*).

Use.—A large proportion of the soil is still covered with wild vegetation. It is suited to all crops grown in this region (fig. 9). Most of the potatoes produced near Fairbanks are grown on it. The land is stone-free and easy to cultivate. Unless managed with care for water disposal, cultivated sloping areas are subject to sheet and gully erosion, especially late in spring.

Distribution.—This is the dominant soil on the lower valley slopes and ridges of the Tanana Valley.

Gilmore-Fairbanks Soil Association

The Gilmore-Fairbanks soil association occupies a considerable strip of country northeast of Fairbanks at elevations of below 2,000 feet. The elevation of Fairbanks is below 500 feet. This soil association covers the transition between the Tanana Valley and the Tanana-Yukon area to the north and northeast.

In contrast to the Fairbanks, previously described, the Gilmore soils are developed from weathered materials derived from the country rock—almost entirely micaceous schist. Part of the silty very fine sand of the surface horizons may be of wind-blown origin, similar to that of the Fairbanks soils; but the subsoil material is derived from the schist bedrock. Within the Gilmore group are several local soil types and phases, varying in depth to hard rock—1 to 30 feet—and in slope from nearly level to strongly sloping. Small areas of deep soils developed from the local alluvium from the sloping Gilmore Soils are found near the base of long slopes.

Within this soil association are small areas of Goldstream silt loam, briefly described under the Tanana soil association. Besides, there are small areas of rock outcrop and larger ones of thin soils, a foot or less in depth over the bedrock. Such lithosolic soils are often referred to as "rock outcrop land."

Mine Tailings

The type of land known as mine tailings results from the placer mining operations so active in this area (fig. 10). The original soils of the valley—mainly Goldstream and Tanana—were derived largely from alluvial materials. These included beds of silt, clay, sand, gravel, muck, and peat, often with blocks of ice. The thick silty organic layers are called "muck" by the miners. In the process of reworking, the soils are destroyed, and coarse gravel, cobbles, and stones are left in short ridges on the surface of the valley. Large areas have been laid waste.

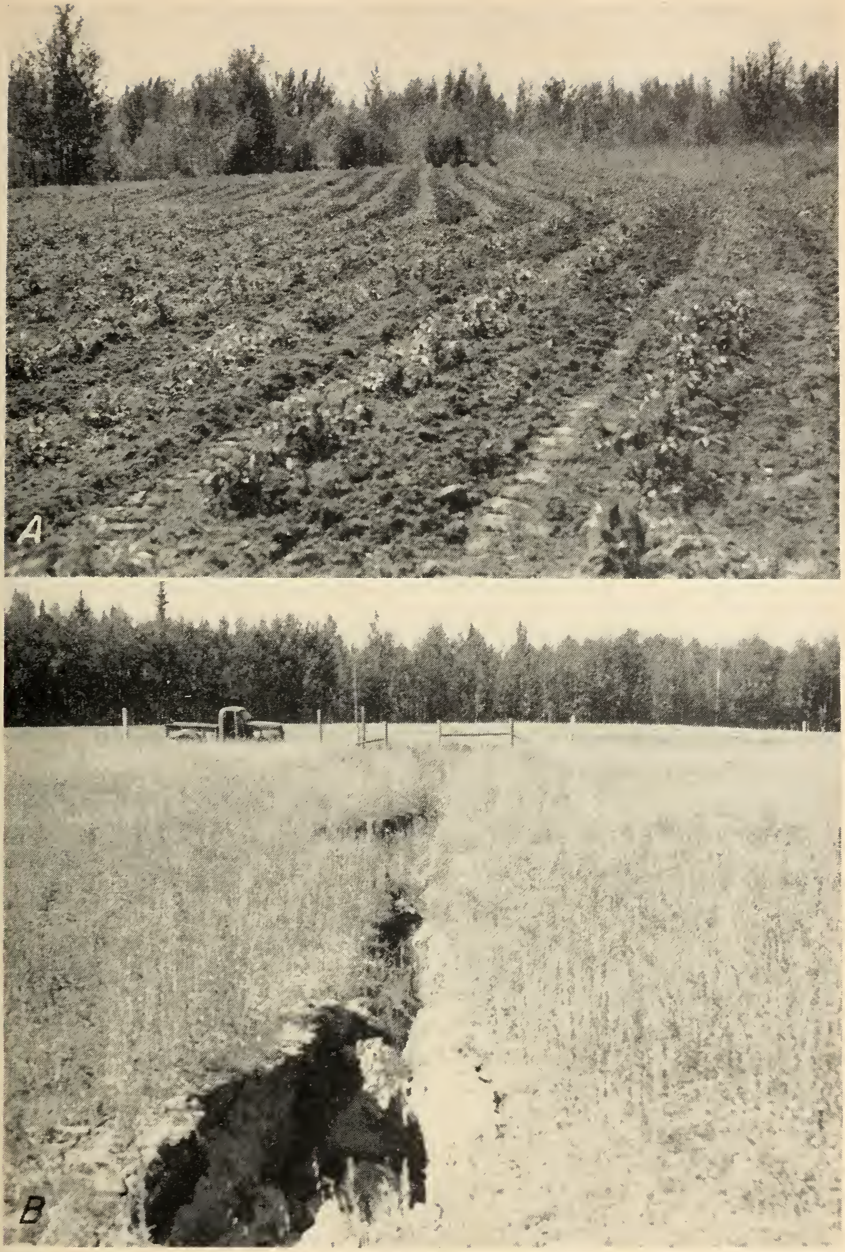

FIGURE 9.—*A*, Potatoes growing on Fairbanks soils, which are suited to all crops grown around Fairbanks. *B*, A gully developing in Fairbanks soil. Both erosion and the melting of ice underground contribute to gullying in these soils after a period of continuous cropping.

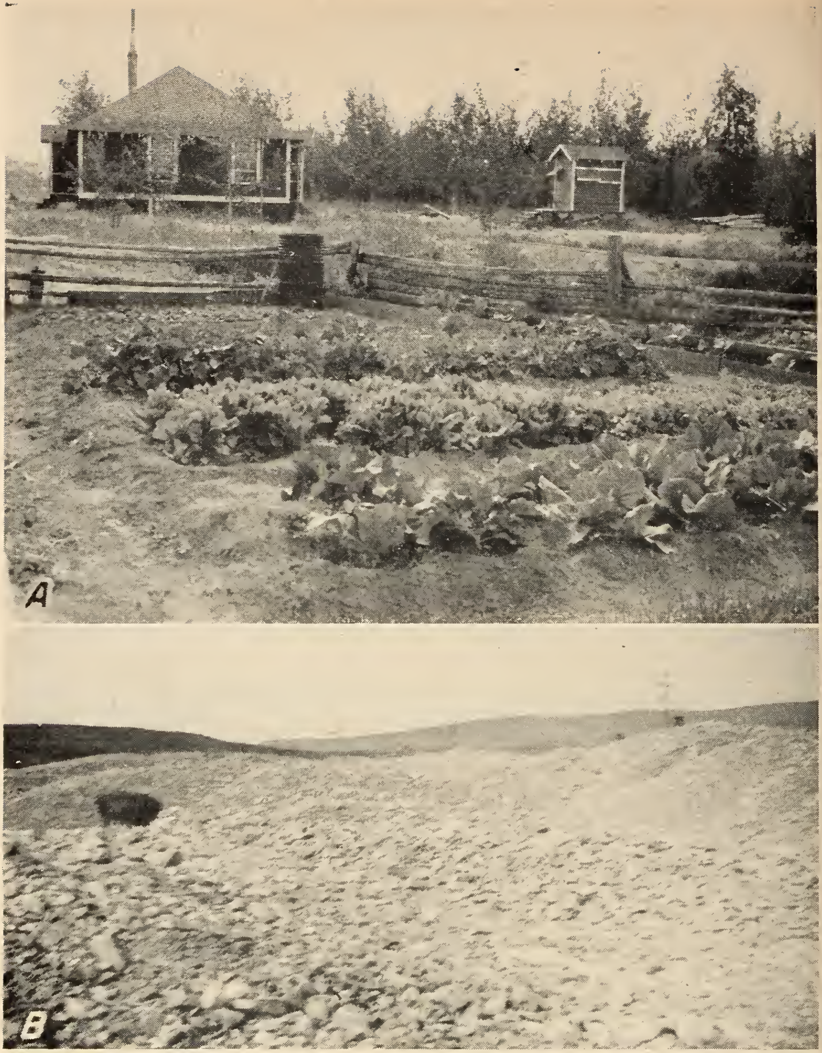

FIGURE 10.—Some valley soils have been destroyed and laid waste by mining operations. *A*, The same soil that here supports a garden is side by side in the Goldstream Valley, near Fox, with an area, *B*, of coarse gravel, cobbles, and stones where hydraulic mining operations have reworked and destroyed the soil.

AGRICULTURAL DEVELOPMENT IN THE TANANA VALLEY

Agriculture originated here as an overflow from mining. People coming to mine first obtained a homestead, largely for firewood, and cleared a few acres for hay and oats for horses used in harvesting wood. In 1919 coal mines were opened and coal began to compete with wood. By then, much of the birch wood had already been cut and the farmer-woodcutters were getting old. Many were bachelors. Those who were married moved to town in order to send their children to school.

Crop acreage has always been low in this area. The agriculture is still that of the frontier . During the past 5 years the crop acreage has increased because of the stimulus of war, but the number of acres now in actual cultivation is still low. Gasser (*14*), in his informative report, The Tanana Valley, gives a figure of 1,400 cultivated acres in the Tanana Valley. In the "Tanana Valley" he includes the lower Tanana Valley from Big Delta, at the junction of the Delta and Tanana Rivers, down to the Yukon River, as well as the community around Fairbanks, an area approximately 205 miles long and 20 to 60 miles wide.

The main field crops grown in the area are oats, oats and peas, barley, and spring wheat. The oats are generally harvested for hay, and the oats and peas for silage. Small grains mature on such favorable spots as the south-facing slopes of Fairbanks very fine sandy loam and Fairbanks fine sandy loam and on the better drained members of the Tanana soils.

Vegetable growing is most important. All hardy garden vegetables are successfully grown outside, and tomatoes and cucumbers under glass. The main cultivated crop is potatoes. Strawberries and raspberries are produced for home use and, to a limited extent, commercially.

Two successful dairy farms are operating on Tanana soils, and there is a dairy herd at the college, mainly on Fairbanks soil.

MATANUSKA VALLEY (LOWER MATANUSKA VALLEY AND KNIK ARM)

Location, transportation, climate, and soils combine to make the Matanuska Valley the most promising for agriculture of any area in Alaska. It now supports more full-time farmers than any other area in the Territory. Because there are many farms, opportunity exists to study the response of soils to management under different types of farming. In fact, the best sources of information are the families actually living on the land, using different soils, growing different crops and animals, and employing different practices.

These farmers are "experiment-minded" to an unusual degree. Nearly every farmer has some trials of crops, fertilizers, and new practices under way. Many showed amazing resourcefulness in adapting the principles of bulletins and books intended for use in the mainland of the United States to their own conditions. Many of their problems, however, are unique, and they lack the facilities and training for fundamental research.

This area has the agricultural resources to maintain a larger population. Nearby are high range lands associated with land suitable for growing feed crops necessary for the long winter period (fig. 11). But to support a stable farm population and meet competition from the outside, good husbandry must be practiced. The soils are highly variable and, on the whole, responsive to good soil management. As in most of Alaska and unlike many parts of the mainland of the United States, the environment has produced soils unable, even immediately after clearing, to give high yields of farm crops without applications of fertilizers.

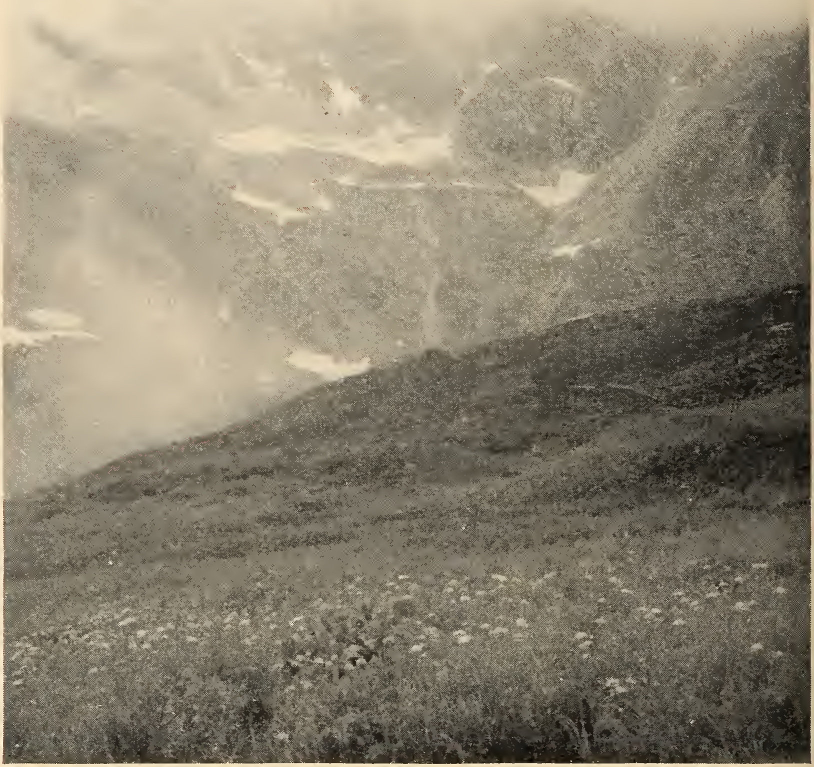

FIGURE 11.—High range land on the mountain slopes north of and above Palmer in the Matanuska Valley would furnish summer grazing.

By clearing off the protective cover of trees, bushes, moss, and organic mats from these soils and exposing them directly to the rays of the sun, enormous changes are made in their biological, chemical, and physical properties. Through research, methods of management can be learned to take advantage of their potentialities and maintain their productivity over the years.

Physiography.—Broadly speaking, this part of south-central Alaska occupies the lowlands of the Matanuska Valley below Chickaloon, at elevations slightly below 1,000 feet. Elevations drop rapidly to the southwest to less than 500 feet near Palmer, and the valley merges with the lowlands of the Knik Valley. Finally, on the west, it merges with the broad terraces and flats of the Susitna River north of the Knik Arm. The Talkeetna Mountains lie to the north and the Chugach Mountains to the south and southeast. The Valley includes the lower mountain slopes as well as the broad flat plains and benches.

The main area studied radiates in all directions from the village of Palmer, which is about 50 miles northeast of Anchorage. From Palmer it extends northeast to Moose Creek, south and southwest to the Knik River and the Knik Arm, and west to the village of Wasilla and southwest of that village.

For the most part, the area consists of rather prominent high terraces extending like steps up the valley to the north and northeast of Palmer, broadening and dropping to the south, southwest, and west of Palmer, and merging on the west with the broad terraces and flats of the Susitna River and on the southwest with the tidal flats. Besides terraces, there are morainic ridges of gravel, cobbles, and sand, as well as hillocks, dunes, kettle holes, lakes, lake deposits, peat bogs, alluvial bottomlands, and tidal flats. Nearly everywhere the valley proper is underlain by loose mixtures of gravel, cobbles, and sand in varying proportions. In the valley are extensive areas of moderately well drained and poorly drained land with few slopes too steep for farming. Yet the many local soil types vary greatly in their management requirements.

Climate.—The winters are not so cold here as in the Fairbanks area, the summers are not quite so warm and sunny, the rainfall is slightly higher, the growing season is a little longer, and there are sometimes strong winds. Although at a lower latitude than the Tanana Valley, this region has long winters, short summers, and almost continuous daylight during the growing period. At the time of the summer solstice at this latitude (between 61° and 62°) the sun is below the horizon for only a few hours. The overage July temperature is 58° F., slightly lower than at Duluth, Minn.; the average January temperature is −13°, about that of St. Paul and Minneapolis, Minn.

The average date of the last killing frost in spring is May 24 and the average date of the first killing frost in fall is September 10. The annual precipitation ranges from 13 to 18 inches. The spring and early summer months have the lowest precipitation; late summer and early fall the highest. Although rainfall is usually adequate for crops on most soils, farm practices must take account of the need to conserve moisture early in summer. Cloudy, misty, and rainy weather late in summer sometimes delays harvesting. Rather heavy windstorms occasionally occur. The cold "Matanuska" winds generally enter the valley from the northeast and are said to occur more frequently during late fall and winter; the warmer and more moist Knik winds enter the valley from the southeast or east and are reported to occur at any season, but more often in winter and early spring.

Vegetation.—Many native plants besides those reported for the Tanana Valley grow here. As in the Tanana Valley, vegetation has been disturbed by frequent fires. Nearly everywhere the valley floor was covered with trees, the most common of which are white birch, white spruce, balsam poplar, and quaking aspen. Alders and willows are common tall shrubs. On the well-drained soils are usually good stands of tall white birch in which are intermingled thinner stands of white spruce and poplar.

Underneath the moderately dense forest is a ground cover of ferns, currants, highbush cranberry (*Viburnum*), wild rose, horsetail (*Equisetum*), bluetop (*Calamagrostis*), and dwarf dogwood. Timber extends up the valley slopes to about 2,000 feet, depending on soil and direction of slope. The treeless tidal flats are chiefly covered with beach wild-rye, bluetop, and alkali-grass (*Puccinellia*).

SOILS

The soils of this valley have developed from water- and wind-sorted materials under cool and moist conditions like those of the Tanana Valley near Fairbanks, but without permafrost and under a somewhat heavier growth of trees. Although these soils are not permanently frozen beneath, the subsoil is too cold for the deep extension of plant roots. Most of the soils have developed from silty very fine sandy materials laid over a base of water-sorted glacial drift, consisting of mixtures of gravel, cobbles, and sand in varying proportions. The thickness of the fine materials—silt loam, very fine sandy loam, very fine sand, fine sandy loam, and fine sand—overlying the coarse base varies from a thin smear to more than 6 feet. Thickness of the fine material is important, since it bears a close relationship to the internal characteristics of the soils and to their ability to retain moisture and supply nutrients to plants.

The thickness of this soil material over the coarse base does not follow so simple a pattern as in the Tanana Valley. It is difficult, therefore, to relate the soil associations here to definite land forms based on surface configuration. Soils developed from a deep deposit of fine material under relatively good drainage conditions are included with the Bodenburg Soil Association (fig. 12). They occur in the vicinity of Palmer and extend east and south of the village to the banks and flood plain of the Matanuska River, about 1 and 2½ miles respectively, and southwest several miles to the poorly drained flats near the railway station of Matanuska. Their extension west and northwest from Palmer varies between 2½ and 3 miles. Farther west the deposit of fine material gradually thins out and nearly disappears. Soils to the west and near the village of Wasilla are developed on the thin deposits of fine materials over the coarse base. Soils on sloping terraces, generally having less than 8 percent gradient, are included in the Knik soil association (fig. 13). Large areas on steep slopes are referred to as rough pitted land (fig. 14). On the higher benches south of the Talkeetna Mountains, northwest of Palmer and northeast of Wasilla, are soils similar to the Knik but more highly podzolized. Southwest of Wasilla towards the village of Knik and beyond are sandy podzolized soils. To the south, between this area and Knik Arm, are large tidal flats.

Bodenburg Soil Association

The Bodenburg soil series makes up fully 75 percent of the Bodenburg soil association. Poorly drained soils, dunes, rough broken land, and Knik soils occupy most of the remaining area. Bodenburg soils are mellow, often fluffy, moderately well drained, stone-free, and nearly level or undulating. They are easy to cultivate.

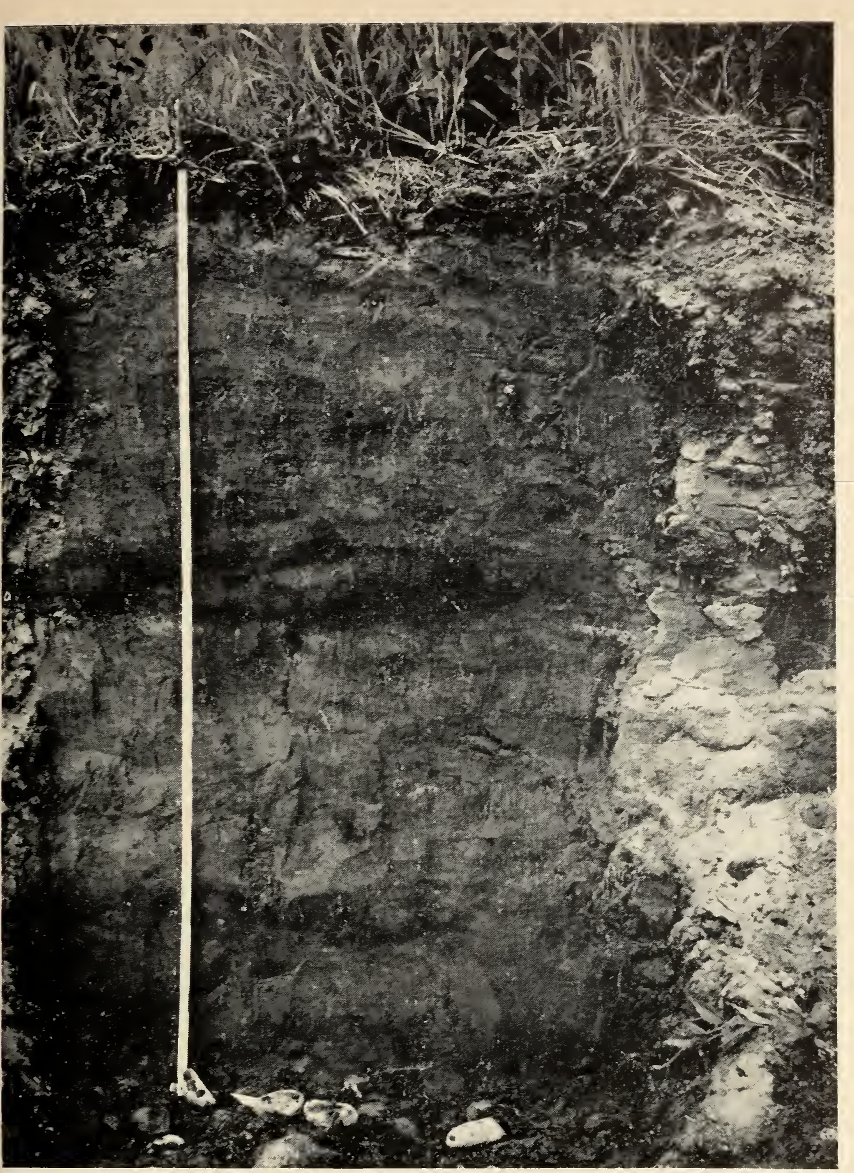

FIGURE 12.—A soil profile of Bodenburg very fine sandy loam in the Matanuska Valley northwest of Palmer, showing base of cobbles and coarse gravel at the lower part.

Bodenburg Series

The Bodenburg series includes young soils developed from silty very fine sands and fine sandy materials, presumably wind-laid over a base of glacial gravel, cobbles, and sand of varying proportions under the subarctic conditions of southcentral Alaska (fig. 12). Following is a description of the Bodenburg very fine sandy loam under virgin conditions.

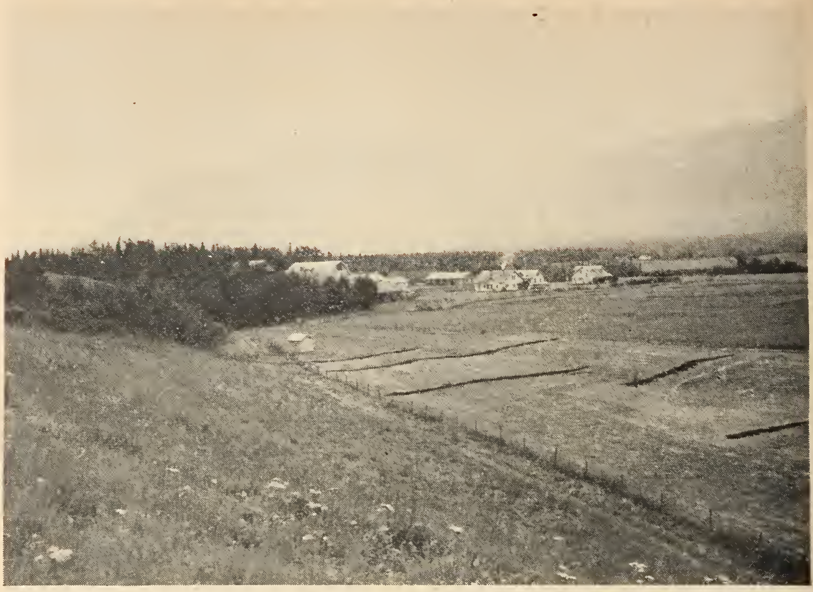

Figure 13.—Soils on nearly level to sloping terraces developed on thin deposits of fine material over the coarse base are included in the Knik soil association. Tame hay pasture in foreground, windrowed hay meadow on the lower land, and buildings of the Matanuska Experiment Station beyond. Chugach Mountains in the background.

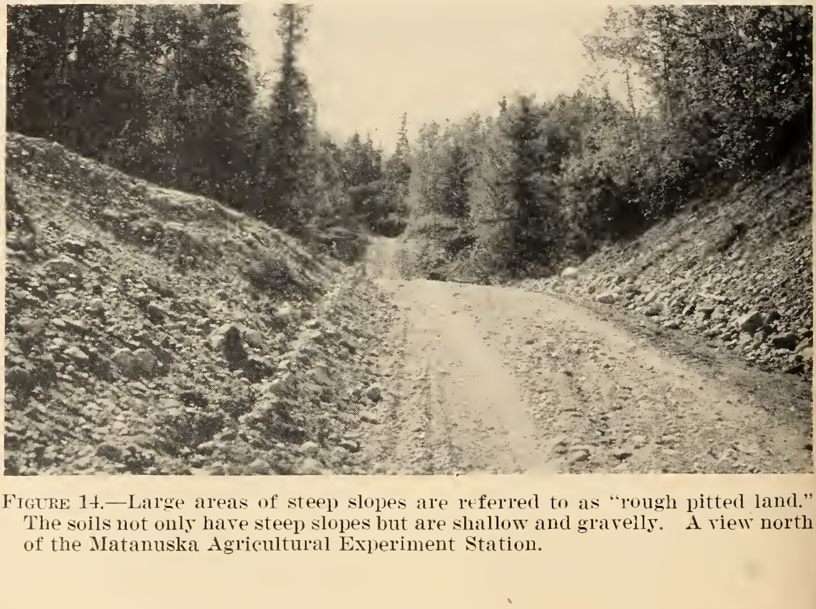

Figure 14.—Large areas of steep slopes are referred to as "rough pitted land." The soils not only have steep slopes but are shallow and gravelly. A view north of the Matanuska Agricultural Experiment Station.

Soil profile

(1) A_{00}. Weak brown organic mat made up of nearly fresh leaves; 1 to 2 inches thick.

(2) A_0. Dark yellowish-brown and weak brown organic matter containing many live roots; 1 to 3 inches thick.

(3) A_1. Dusky-brown humus soil. Very thin—less than ½ inch thick.

(4) A_2. Light grayish-brown very fine sandy loam, mottled with moderate brown and dark brown (organic): mellow: fluffy, weak platy structure. This layer contains many live roots and some organic matter; 3 to 5 inches thick.

(5) G_1. Grayish-brown very fine sandy loam, mottled with yellowish-brown and light gray: weak platy structure: compact in place but easily friable when removed; few roots. About 12 to 18 inches thick.

(6) C or G. Mottled yellowish-brown and light gray very fine sandy loam; 10 inches and more in depth.

(7) D. Water-sorted cobbles and gravel with some sand of mixed lithological composition (at about 40 to 60 inches).

Range in characteristics.—Layers A_{00} and A_0 may be partially destroyed by fire or land clearing. Layer A_1 may be absent. The degree of mottling in the lower layers may vary considerably. Depth to the D layer varies from 3 to more than 5 feet.

Topography.—Nearly level to undulating, or billowy, surfaces on generally smooth outwash plains and terraces (fig. 15).

Drainage.—Moderately good: good after clearing.

Vegetation.—The tall-tree stratum consists largely of white birch with many white spruces and a few poplars. The lower cover consists generally of red currant, wild rose, highbush cranberry, ferns, horsetails, dwarf dogwood, and a few mosses, with dwarf heath shrubs in some places.

Use.—Much of this soil is being used for vegetable crops, potatoes, and small grains. Some is in pasture. Exposed, unprotected knolls are subject to soil blowing.

Distribution.—One of the prominent soils in the vicinity of Palmer.

Knik Soil Association

Knik soils occupy about 75 percent of the Knik soil association, most of the remainder consisting of rough pitted land, poorly drained soils, and a few lakes. Rough pitted land often borders the lakes.

Like the Bodenburg soils these are loose, friable, and stone-free. They are easy to cultivate and are being farmed much the same way as the Bodenburg. Since they are slightly better drained, they warm up a little earlier in spring.

The soil profile of the Knik series differs from that of the Bodenburg in having (1) more distinct horizons, showing some evidence of podzolization: (2) a slightly lighter colored surface and subsurface: (3) a more yellowish-brown subsoil: and (4) a shallower depth (20 to 30 inches) of fine material over the coarse base. The coarser base may contain a greater proportion of sand. Under virgin conditions, a very thin layer of light-gray to reddish-gray very fine sandy loam generally occurs below the organic mat.

Sandy Podzols

The sandy Podzol soil association occupies a large sand plain southwest of Wasilla near Knik, and between Knik and Goose Bay. This area consists essentially of an unnamed sandy Podzol and several peat bogs. These soils are not being cultivated. The native vegetation consists largely of white birch, quaking aspen, and white spruce.

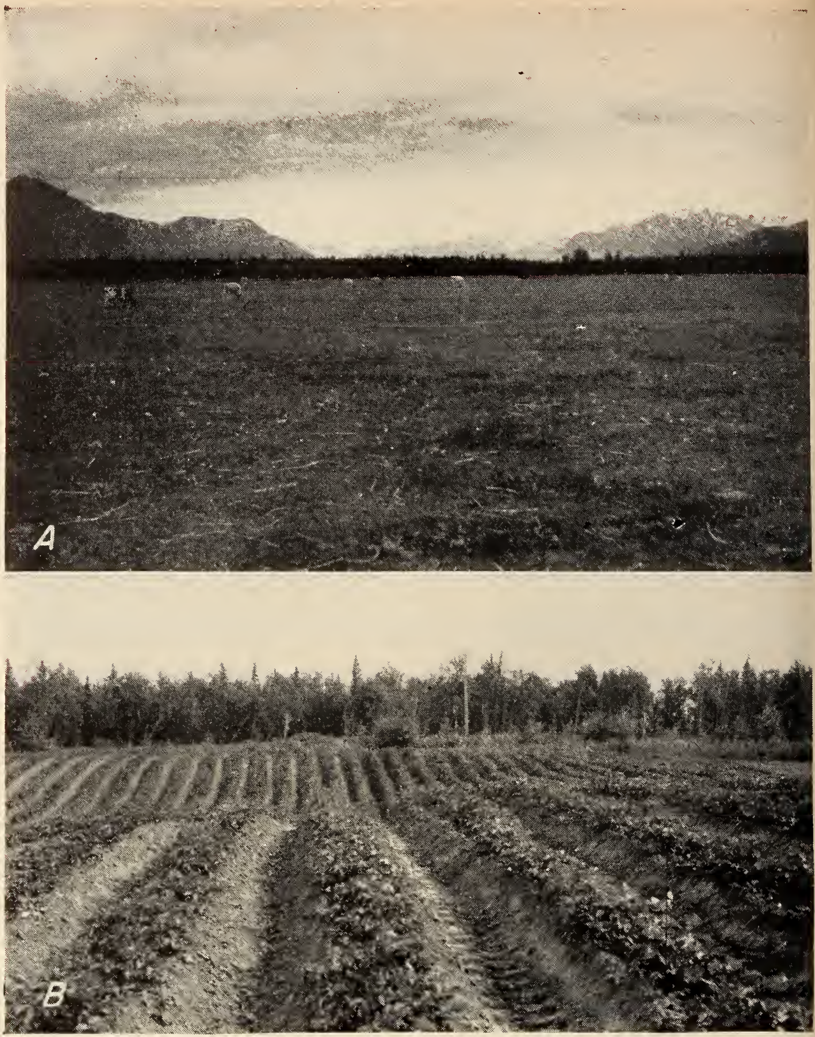

FIGURE 15.—Better agricultural soils in the Matanuska Valley, such as the Bodenburg, have nearly level to undulating (billowy) surfaces. *A*, Pasture south of Palmer on nearly level and gently undulating Bodenburg very fine sandy loam. *B*, potato field northwest of Palmer on the same soil type, with characteristic billowy topography; potato rows are on the ridges.

The prominent soils have developed on glacial outwash sand and are like the sandy soils near Spenard Lake southwest of Anchorage, to be discussed later. Under virgin conditions, this soil consists of (1) a dusky-brown fibrous organic mat, 1 to 3 inches thick; (2) an underlying layer of yellowish-gray loamy very fine sand, 2 to 3 inches thick; and (3) a lower layer of yellowish-brown, weakly-cemented fine sandy loam, 3 to 6 inches thick; this grades below into (4) loose medium-to-fine sand of mixed composition.

Tidal Flats

Tidal flats make up an area of more than 15 square miles along the Knik Arm, starting at the Indian village of Knik and extending for almost 10 miles east. A typical profile on the drier part of this flat consists of (1) a 6-inch surface layer of weak brown sedge peat, impregnated with bluish silt; (2) a 6-inch subsurface layer of wet bluish-gray silt loam, high in organic matter and containing many roots; and (3) a wet bluish silt loam subsoil, containing a few roots and a few thin seams of reed peat. Parts of this flat are used for pasture and hay. The typical vegetation consists of sedges, wild-rye, lupines, and bluetop. In the wetter part of the flat is a large alkali-grass (*Puccinellia*) (fig. 16).

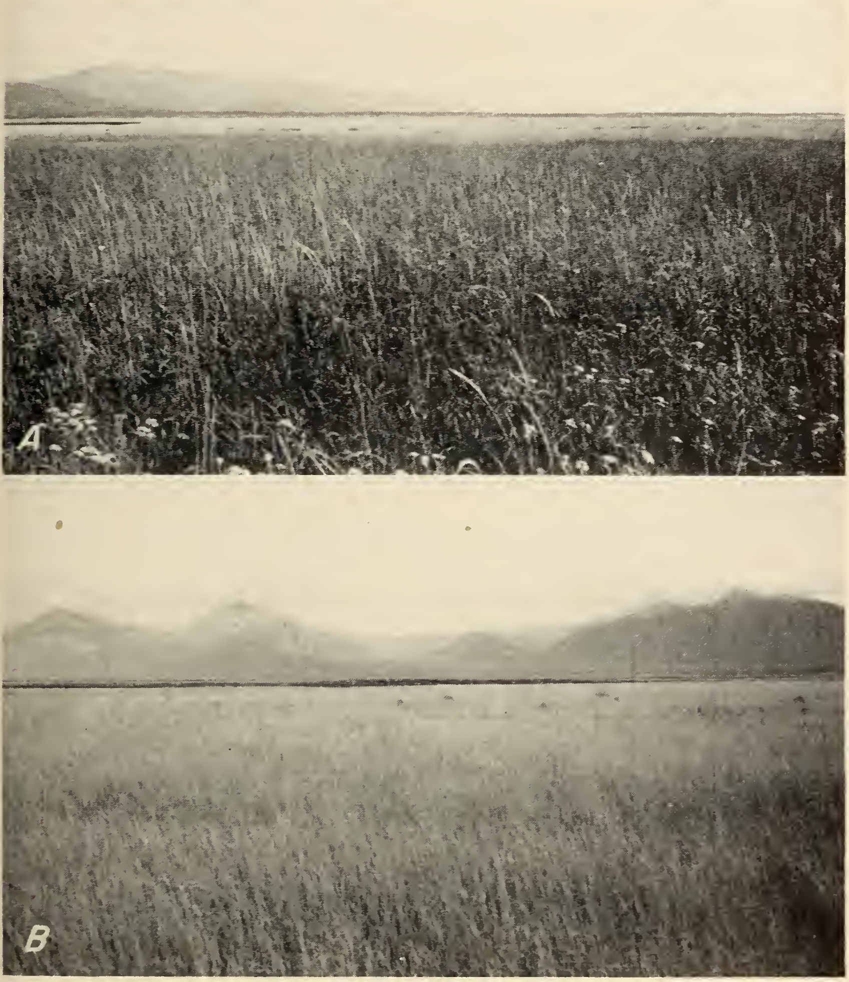

Figure 16.—Parts of the tidal flats on the north shore of Knik Arm southwest of Wasilla are used for pasture and hay. A, Drier portion of the flat with typical vegetation of sedges, beach wild-rye, lupines, and bluetop. *B*, Wetter portion, with alkali-grass (*Puccinellia*).

As far back as 1913 many homesteads in the Matanuska Valley were occupied by trappers, fishermen, miners, and a few farmers. It is reported that at that time there were more than 400 holdings, including most of the more easily accessible and more level land. During World War I the homesteaders carried on some farming, but immediately thereafter many left. Many of the holdings became vacant, and others, especially those more accessible, changed hands several times. When the Matanuska colonists arrived in the summer of 1935 there were about 75 "old settler" farms.

About 250 farm families were in the valley in 1946, 140 of them in the Matanuska Valley project area, often referred to as the Matanuska Colony. These included 52 of the 200 original families. Land clearing has been accelerated by use of bulldozers during the past few years, until now about 8,000 acres are cleared.

The chief types of farming are truck farming, dairying, and general farming. Most farmers grow some truck crops; a few devote all their time to truck farming; and there are about 20 dairy farms. Most of the farmers sell their crops to their cooperative. Development in this area is handicapped by the fact that many areas of the better soils, such as the Bodenburg, near the trade center of Palmer are held by nonresident owners, who pay no taxes. For further details see the booklets, The Matanuska Valley (*15*) and Agriculture in the Matanuska Valley (*17*).

ANCHORAGE AREA

In the immediate vicinity of the city of Anchorage is a limited area of soil that warrants more intensive use for crop production under part-time farming. In the northern Lake States, such soils are considered as marginal for farm use, but here their location gives them a great advantage for use by people working in Anchorage. Families can live near their work and on small tracts of a few acres supplement their living with vegetables, small fruits, and poultry.

Physiography.—This area occupies the lowland, or piedmont plain, east of Point Campbell between Knik and Turnagain Arms. These lowlands are formed by a filling-in of delta deposits from glacial streams encroaching upon the area of tidal water. They are made up of deposits of sand and gravel and are dotted with peat bogs and lakes. Some mud flats are visible at low tide. The area is bordered on the east by the Chugach Mountains.

Climate.—The climatic conditions are much like those of the Matanuska Valley, transitional between coast and interior. The average annual precipitation in Anchorage is 14.5 inches, compared with 15.6 at Matanuska. The average July temperature is 57° F. The average January temperature is 11.2°.

Vegetation.—The native plant cover in this far northern region is much like that of sand and peat areas in the northern Lake States. Well-forested sandy areas are dotted with open and semiopen bogs (muskegs) and a few sand dunes, lakes, and ponds. The vegetation and surface soil indicate burning. Common trees are spruce, white birch, and quaking aspen; common shrubs are dwarf heath plants (*Ledum*, *Vaccinium*, *Andromeda*, *Kalmia*), along with the very common crowberry. On wet sands around ponds and muskegs are stands of scrubby black spruce, dwarf birch (*Betula glandulosa*), and dwarf heath shrubs. Quaking mats composed of sphagnum moss, sedges (*Carex*), and cottongrass (*Eriophorum*) border many lakes and ponds.

SOILS

The soils in this area, like the vegetation, are similar to those of sandy outwash plains in the northern Lake States. Also they are like the sandy Podzols north of Knik Arm, near the village of Knik, and between Knik and Goose Bay. The main soil area not in reservations lies on sandy terraces southwest of Anchorage along the Spenard Road. The profile of a typical soil along this road, 1½ miles south of Anchorage, is described below. It has a cover of white birch, aspen, and spruce, with an undergrowth of blueberry, Labrador-tea, crowberry, and Polytrichum moss.

Soil profile

(1) A_0. Dusky-brown fibrous leaf and root mat; 2 to 3 inches thick.

(2) A_1. Dusky-brown to brownish-black humus soil. About one-fourth inch thick.

(3) A_2. Light-gray to reddish-gray very fine sandy loam (specked with yellowish-brown); weak fine platy structure; friable; many roots; 3 inches thick.

(4) B_2. Strong yellowish-brown fine sandy loam; slightly cemented; many roots. (This is an orterde, with a few particles of ortstein.) 7 inches thick.

(5) B_3. Light yellowish-brown fine sandy loam; very few roots; 4 inches thick.

(6) C. Loose sand of mixed composition but high in dark-colored minerals. Below 14 inches.

The soil in the muskegs consists mainly of a surface of yellowish-brown spongy sphagnum moss peat some 6 to 24 inches thick, underlain by brown matted fibrous sedge peat. In places the underlying sedge peat contains an admixture of woody peat. Seams of volcanic ash are often found in the underlying layers.

AGRICULTURAL DEVELOPMENT

Many part-time farms of about 2 to 5 acres are located along the Spenard Road and many more tracts still remain in timber. The main crops grown are vegetables, including potatoes. Some nursery crops were seen and a few larger fields of small grains (fig. 17). The crops examined in this area show the need of more fertilizer. Some crops show symptoms of deficiencies of the minor elements necessary for plant nutrition. Such evidences include yellowing and marginal necrosis of growing bean leaves, and gray spots, with brown leaf tips and leaf margins, on barley and oats.

BIG SUSITNA AREA

The Big Susitna area was not visited by any member of the exploratory party because of inadequate time, but was referred to by Don L. Irwin, general manager, Alaska Rural Rehabilitation Corp., at Palmer, as a soil area for consideration. It includes a broad belt along the lower Susitna River, along the lower Yetna River at its confluence with the Susitna, and fronting Cook Inlet and its tributaries. The climate reported for this area is similar to that of the Anchorage and Matanuska areas except for more precipitation.

Based on what was seen of this area from railroad and other maps, the soils are probably similar to those on the benches fronting Cook

Inlet. These benches rise steplike from above tide to more than 1,000 feet up the Susitna. Possibly soils suited to agriculture may be found here. How extensive they are will remain unknown until a detailed survey can be made. It is known, however, that there are broad stretches of wet areas, muskegs, marshes, and steep ridges unsuitable for agriculture. Soils of these swampy areas include floating bogs dangerous to walk over.

The area has remained undeveloped even though it was reported by Eldredge (*12*) as far back as 1900 as having some agricultural promise. He stated that native grass grows profusely in many parts of the area: that at Tyonek, rye and oats grow to full head; and that below the mouth of the Yetna, Indians raise potatoes and other vegetables.

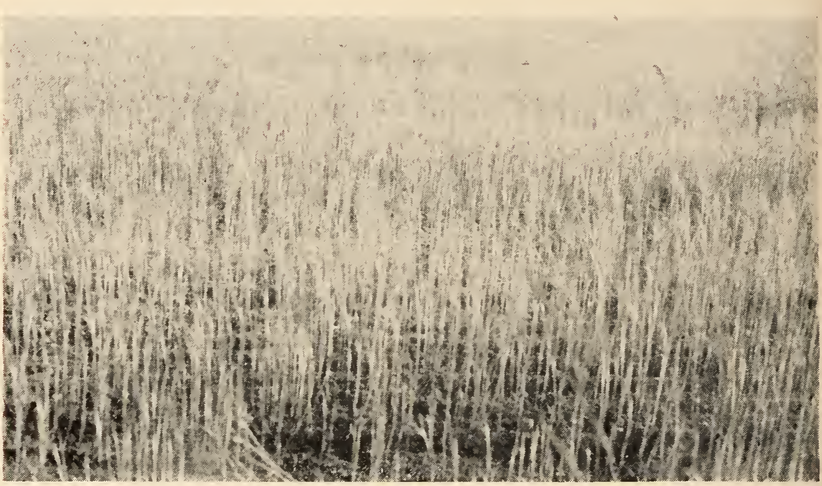

FIGURE 17.—A few fields of small grains are seen southwest of Anchorage along the Spenard Lake road. Barley plants on this field have made a poor growth and show symptoms of needing fertilizer.

WESTERN KENAI PENINSULA

HOMER AREA

Much has been said and written about the Homer area as a region of agricultural promise and even of its possible superiority over the Matanuska Valley as a colonization site. On the whole, the soils are fair to good for crop use and mostly medium-textured, moderately dark-colored, and moderately well-drained. The growth of crops, however, is slow in spring and throughout the growing season—so slow that small grains do not ripen. As late as August 15 (1946) wild gooseberries and currants were just beginning to ripen and raspberries were several weeks away from ripening. The most promising agricultural enterprises for this area appear to be stock raising, dairying, and the production of cool-season vegetables. Stock raising makes use of the grasses and legumes, which are the crops best adapted to this climate (fig. 18).

Physiography.—Two broad general land forms are dominant: (1) A broad gently sloping lowland fronting Kachemak Bay, known as the

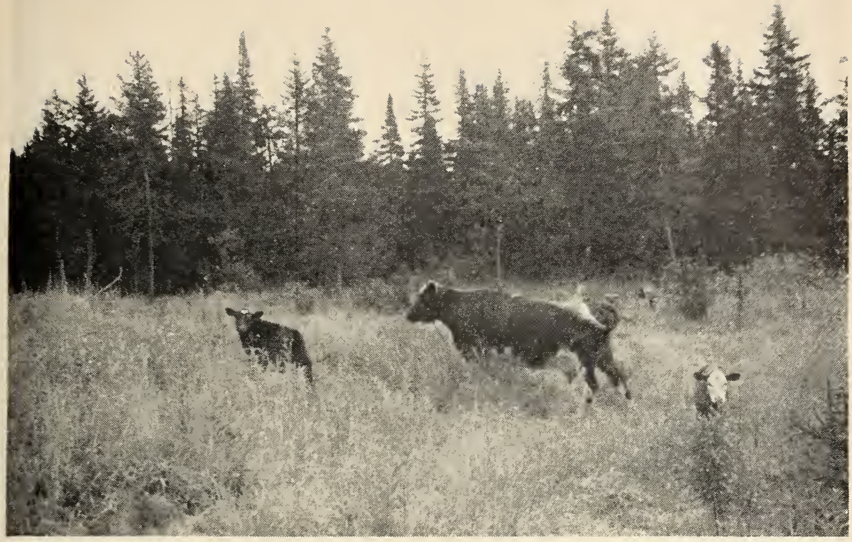

FIGURE 18.—Cattle on rank bluetop grass on the Kenai Plateau, higher rolling upland north of and above the Homer Bench. Stock raising makes best use of grasses, a crop well suited to the climate and soils of the western Kenai Peninsula.

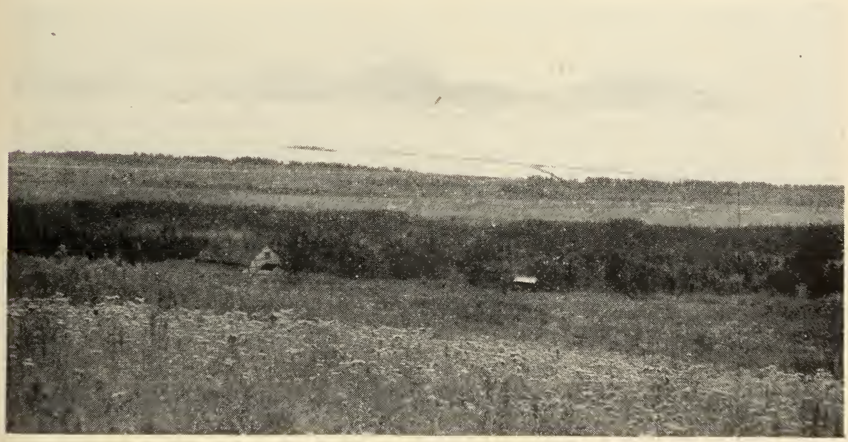

FIGURE 19.—The Homer Bench is a broad, gently sloping lowland fronting Kachemak Bay. Looking south from the upper part of the bench, showing Homer Spit extending out into the bay; Kenai Mountains in the background.

Homer Bench, on which the settlement of Homer is located (fig. 19). This bench, excluding the tidal marsh, consists of about 12,000 acres in an area approximately 1 mile wide and 17 miles long. The lower part appears to be glacial till, and the upper part is glacial outwash. The till is thick and the surfaces are generally terraced where overlain by sand and gravel.

(2) A higher rolling upland forming the southern extension of the Kenai Plateau above and north of the Homer Bench. This rolling plateau consists largely of Tertiary rocks, like shales and sandstones in places, overlain by glacial till and silty deposits, presumably windlaid.

Climate.—The climate of this area is tempered by warm winds from the Pacific Ocean. It is comparatively mild—cool in summer and without extreme cold in winter. The average July temperature is 54.8° F. The spring season is generally late and cool, and the summer and fall also are cool. The sky is often overcast; and there are many drizzling rains. The average annual rainfall at Homer is 32.9 inches. Snowfall averages 98.7 inches per year.

Vegetation.—The native cover on the bench consists largely of a forest of spruce, white birch, poplar, alder, willow, and elderberry, within which are scattered many open (burned-over) areas covered mostly with bluetop (*Calamagrostis*), sedges, and fireweed. Thick stands of spruce are common in the lower part of the bench near the bay. Beach wild-rye is found along the spit. Hemlock occurs in some localities. The timber may be thinning out, since settlers report less on farms now than when they first came. The native cover on the upland plateau consists of tall grasses, mainly bluetop, along with clumps of spruce trees (fig. 20).

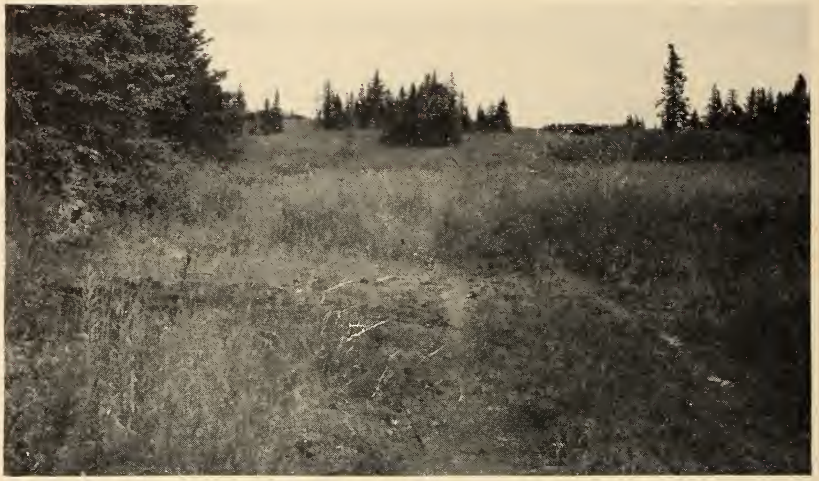

FIGURE 20.—The native cover on the upland plateau above and to the north of Homer consists of tall grasses, mainly bluetop, in which are interspersed clumps of spruce.

Soils

The soils on the bench are rather variable, since they reflect different geological materials and various drainage conditions. The parent materials of the soils consist mainly of glacial moraines and valley fills. Many gravelly moraines are found lying more or less parallel, the swales between them filled with alluvial materials. The soil on which most of the crops are grown has a grayish-brown friable silt loam surface soil, 6 to 10 inches thick, underlain by a mottled light-gray and yellowish-brown subsoil 5 to 10 inches thick. The subsoil grades into a mottled light olive-gray and yellowish-brown friable silt loam layer, slightly compact in place but friable when removed. Beneath this lower layer is one of interbedded heavy silt loam and fine sandy loam, mottled brown, yellowish brown, and olive gray.

The soils on the upland plateau, on the other hand, are more nearly uniform and cover a large area that is undulating to rolling.

Kenai Series

The Kenai series, the predominant soil, includes soil developed from thick silty deposits over shales and sandstones on an undulating to rolling plateau under subarctic conditions in south-central Alaska.

Soil profile

(1) A_0. Dark yellowish-brown tough; fibrous root mat, often containing charcoal; 2 to 3 inches thick.

(2) A_1. Dark yellowish-brown to dusky-brown silt loam containing numerous live grass roots; fine granular structure; friable; soft; 2 to 4 inches thick.

(3) A_3. Dark-brown to dusky-brown silt loam; roots not so numerous as in the layer above; granular; friable; 2 to 3 inches thick.

(4) B_2. Dark reddish-brown to brown silt loam; many roots; irregularly granular structure; friable; 2 to 3 inches thick.

(5) B_3. Yellowish-brown silt loam slightly mottled with light gray; few to many roots; weak irregularly granular structure; friable; 8 to 12 inches thick.

(6) C. Light yellowish-brown silt loam slightly mottled with light gray; very few roots; friable. This material is reached at 15 to 25 inches from the surface.

Range in characteristics.—Charcoal may be found in the upper two or three layers. The reddish-brown B_2 layer may contain a high content of organic matter. In places a light-gray silty clay loam containing many shale fragments (D layer) may occur within 30 inches of the surface.

Topography.—Undulating to rolling.

Drainage.—Surface drainage is good, and internal drainage moderately good.

Vegetation.—Tall grasses, largely bluetop, with scattered clumps of spruce.

Use.—For pasture and meadow.

Distribution.—This is the dominant soil in the southwestern extension of the Kenai Plateau.

Agricultural Development

A small settlement has been established at Homer, far from any market, with few roads and an inadequate dock. When the new road to Anchorage, now under construction, is completed the area will have a more secure outlet for farm products. The number of settlers increased rapidly in 1946, some pushing back from the bench onto the upland plateau. Many holdings on the bench are occupied by the original settlers or members of their families. Since one or more members of many of these families derive an income from fishing, some holdings serve mainly as home sites.

About four families on the bench make their income from truck farming. Agriculture in this locality appears to be passing from a strictly pioneering to a more competitive type.

Living is made somewhat easier by the fact that moose and other wild game are still plentiful, as well as fish and small fruits, such as cranberries, blueberries, currants, elderberries, and raspberries; and coal can be picked up along the beach or on some farms (fig. 21).

More information about the climate and soils, the adaptability of crops, and the responses of the various soils to management practices is necessary to a solution of many problems. Killing frosts are common on the upland plateau, but the development and use of short-season crops might be successful. Chickweed and horsetail (*Equisetum*) are bad weeds for which no practical control measures have yet been discovered. How to hasten the decomposition of organic matter is a problem. The tough fibrous organic matter of the upland soils decomposes slowly even when plowed under.

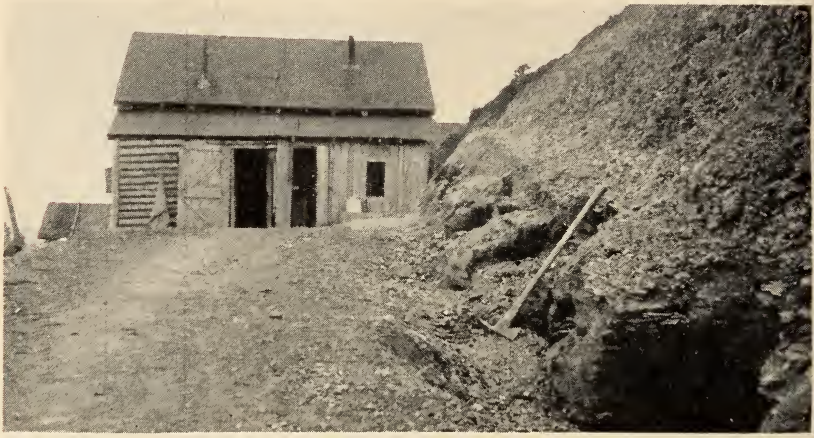

FIGURE 21.—Coal has been plentiful in the Homer area. The back yard of a farm home, showing a coal vein on the right. The mattock is used to dig out coal as needed.

OTHER AREAS IN WESTERN KENAI

Along the west coast, up the Cook Inlet from Homer, near the settlements of Ninilchik, Kasilof, and Kenai, are several lowland areas with soils having possibilities as cropland. The exploratory party did not visit these areas, but information available suggests that most of the better agricultural soils are derived from delta deposits.[4] Upon completion of the new road to Anchorage part of these lands will be accessible.

The Agricultural Experiment Station at Kenai, which was in operation from 1899 to 1908, showed that hardy vegetables can be grown successfully but that small grains do not mature. Precipitation should be adequate. The rainfall decreases from Homer up the Inlet, but at Kenai the average annual rainfall is reported to be 18.6 inches.

COPPER RIVER BASIN

The agricultural possibilities of the Copper River basin have been in doubt for some time. Some foresee great agricultural expansion over its many broad flat surfaces. Others believe that the part along the abandoned Copper River and Northwestern Railroad between the village of Chitina and the abandoned village of McCarthy is more promising than that near Copper Center along the Richardson Highway. They report that the few settlers who farmed the area along the railroad in the days of the Kennecott mining operations were more successful than the few near Copper Center.

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[4] Maps of the Bureau of Land Management indicate some 55 square miles that may be suitable for general crop production, 3 of which are near Ninilchik and the remainder around Kasilof and southeast of Kenai.

A 4-day investigation enabled some members of the party to make a brief study of the Copper River basin. The extent of good agricultural land in any part of this region is considered too small to warrant agricultural settlement at this time. Furthermore, the frequent frosts add a serious hazard to farming. At Copper Center hardy vegetables grow well only if irrigated; but at Long Lake and on the Kennecott flats they do well without irrigation. The growth of more than hardy vegetables, however, is needed to make a living off the land. Just because vegetables can be grown on a soil does not necessarily classify it as agricultural. Though the area has lands for summer grazing, the winter feeding periods are long. For the present this area must be looked upon as of questionable agricultural value.

Physiography.—The area around Copper Center consists of a broad, flat, poorly drained, lake-dotted plain of thick unconsolidated deposits. From Glenn Allen, near the junction of the Glenn and Richardson Highways, and south on the Richardson Highway to about 4 miles beyond the village of Copper Center, terrace faces of this plain are conspicuous and consist generally of a gravelly base at a depth of about 2 feet. Copper Center is situated on a low terrace of the Copper River.

A second part of the Copper River basin follows the tracks of the abandoned Copper River and Northwestern Railroad east of the village of Chitina along the Chitina and Nizina Valleys and the Kennecott flats to the abandoned village of McCarthy. Between Chitina and Long Lake are morainic materials and glacial outwash deposits on undulating to rolling slopes. Long Lake is a remnant of an old drainage course. Bordering it are level deposits of glacial silts and sands. Between Long Lake and McCarthy lie the Kennecott flats, which are alluvial bottomlands. Half a mile northeast of McCarthy is a bench about 50 feet above the alluvial bottomland, and about 200 feet above this bench is a second. South of McCarthy is another high bench, some 9 miles long and 2 miles wide, which merges to the southeast with Sourdough Ridge.

Climate.—Records of precipitation and temperature are not complete but cover a sufficient number of years to give a fairly adequate picture of the climatic conditions. Frosts may occur in the valleys in any month of the year. As in other mountain valleys, many rains are local.

Vegetation.—The plain to the west and northwest of Copper Center is covered with a scrubby growth of black spruce and an undergrowth of dwarf heath shrubs, sphagnum mosses, and lichens. In a few places, slightly burned and moist, are spots of luxuriant grasses and sedges (fig. 22). On the plain south and southeast of Copper Center black spruce predominates in the forest cover, although white spruce, aspen, and other species of poplar may be seen. On the lower terraces and bottom lands near Copper Center aspen and willows are more plentiful. Between Chitina and McCarthy a scrubby stand of

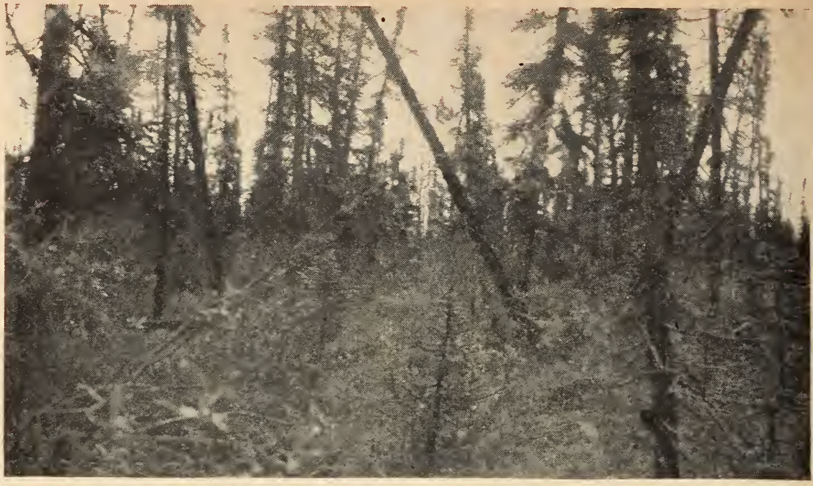

FIGURE 22.—The plain to the west and northwest of Copper Center is covered with a scrubby growth of black spruce and an undergrowth of dwarf heath shrubs, sphagnum mosses, and lichens, under which a Half Bog soil has developed. Scene along Glenn Highway, 14 miles west of its junction with the Richardson Highway.

spruce dominates, with some stands of aspen and willow and a few open areas of bluetop, fireweed, and sedges. On the benches near McCarthy are stands of aspen and willow among which are a few spruce trees, generally small, and an undercover of buffaloberry, lupines, Labrador-tea, and crowberry.

SOILS

The soils of the basin may be generally described as follows:

Copper Center Area

The most extensive soil on the broad plains northwest and southeast of Copper Center is a Half Bog developed over thick unconsolidated deposits.

The soil has a dark yellowish-brown to dark-brown raw peaty mat 3 to 6 inches thick over a dark-brown humus soil generally less than 1 inch thick. This lies upon a silty clay loam some 4 to 8 inches thick, light olive-gray in color, slightly mottled with yellowish-brown and brown, moderately plastic, and cold and wet. This layer, in turn, grades downward into a less mottled light olive-gray massive silty clay loam or clay loam.

The soils on the low terraces and bottom lands vary greatly, particularly in texture. At the airport, the former site of the Copper Center Experiment Station (fig. 23), the soil has a grayish-brown and weak brown, rather loose, loamy fine sand surface layer about 6 inches thick. Below this is a mottled yellowish-brown and light-gray loamy fine sand containing numerous roots. At a depth of 12 to 15 inches there is a loose fine sand of mixed composition that becomes coarser with depth.

The soils adjacent to Long Lake, on which are several farms, have developed on old alluvial and lake-laid deposits. The most extensive type has a dark-brown to dusky-brown tough fibrous mat 3 to 6 inches thick, underlain by light grayish-brown, friable, very fine sandy loam containing many roots and seams of organic matter. This layer, about 6 inches thick, grades into a mottled light yellowish-brown and brown silty very fine sand, slightly compact in place but rather loose when removed. At a depth of 15 to 20 inches there is generally a mixture of sand and gravel.

The soils on four former farm sites on the Kennecott flats have developed on recent alluvium (fig. 24). The soil of the once cultivated field has a grayish-brown fine granular loam surface layer 6 to 10 inches thick. The subsoil is a light grayish-brown fine sandy loam slightly mottled with yellowish brown.

The soils on the high terraces near McCarthy are underlain by coarse sand and gravel at a depth of less than 18 inches. An extensive soil has a dark yellowish-brown friable weakly granular loam surface layer 6 to 10 inches deep. The underlying layer is grayish-brown and yellowish-brown loam; and at a depth of 12 to 18 inches below the surface the soil material consists of gravel and sand of mixed composition.

LAND ALONG ALASKA RAILROAD

The Alaska Railroad serves an area extending from the Gulf of Alaska northward to the Yukon Basin. A trip from Fairbanks to Matanuska made possible some study of the areas along the route. The climate, vegetation, population, animal life, and agriculture of this area are described by Capps (*10*).

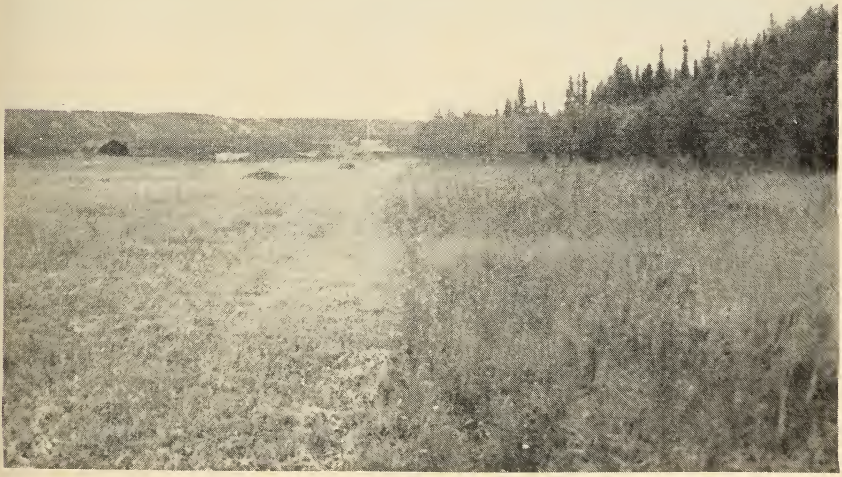

Figure 23.—The Copper Center airport occupies the former site of the Copper Center Agricultural Experiment Station. The soils of the low terraces and bottom lands near Copper Center vary greatly, particularly in texture.

The two really important agricultural areas—the Tanana Valley near Fairbanks and the Matanuska Valley—are served by the railroad, and two others of less importance—the Anchorage area and the Big Susitna area—have already been described.

Two other areas along the railroad stood out as being extensive enough and good enough for limited agricultural use, one near Dunbar, the other between Healy and Lignite. Both have been previously suggested by others as having agricultural promise.

The soils of the Dunbar area are really an extension of the soil associations north of Fairbanks. They are similar to those of the Tanana Valley near Fairbanks. The station of Dunbar is within an area of the Fairbanks soil association. The east extension of this area varies from 3 to 6 miles; the north extension is almost 2 miles. To the southwest, along the track, is a low terrace, varying in width from ½ to 1 mile, that can be regarded as being of Tanana soils; east of this terrace is a rolling upland of Fairbanks and Gilmore soils. These soils extend to the Tanana River. This area, with Dunbar as a center, could be expected to support a small farming community.

Figure 24.—Soil scientist using abandoned suspension tramway across Kennecott River to examine soils on the high terraces near the ghost town of McCarthy.

Near Healy and Lignite, on the north slope of the Alaska Range, is a series of terraces. Generally, the higher ones are less gravelly than the lower. Since these benches are on high elevations, they are nearly treeless. Snow is reported to blow off, leaving the vegetation bare for winter pasture.

South of the Alaska Range on some of the terraces of the Chulitna and Susitna Rivers, over which the railroad runs, it might be possible to establish small general farms like those in the cut-over areas of northern Wisconsin. In the gardens near most of the stations, potatoes generally looked good and vegetable crops seemed fair to good. Some garden crops are poor, owing to low soil fertility, and improvement was pronounced where fertilizers were used.

Podzol soils have developed on the better drained sandy and gravelly terraces. They are similar to many soils found in northern Michigan and Wisconsin and are generally similar to the sandy Podzols described under the Anchorage area. Most of these are too cobbly and gravelly at rather shallow depths for dependable agricultural use. On these terraces are also many wet areas, many peat bogs (muskegs), and a few small lakes.

TANANA-YUKON UPLAND

The Tanana-Yukon upland lies between the Tanana and Yukon lowlands. The part visited along two highways, one from Fairbanks northeast to Circle and another from Fairbanks north to Livengood, is an unglaciated country of dissected ridges and broad valleys. Mertie (*19*) designates the area as the Great Central Plateau province, and the country rock of that part from Fairbanks to the Miller house, 120 miles northeast, and from Fox 25 miles north, as Birch Creek schist; he gives detailed descriptions of the physiography and geology and brief descriptions of the climate and vegetation.

On the hills below the timber line, Gilmore soils are most common. They are Brown Forest soils developed over micaceous schist and discussed under the Fairbanks-Gilmore soil association.

A Lithosolic Arctic mountain Meadow soil was observed on the hills above timberline about 25 miles northeast of Fairbanks. It had developed from schist bedrock under a cover of dominantly dwarf heath shrubs, such as Labrador-tea and blueberry, crowberry, mountain cranberry, mosses, and lichens (reindeer moss), in which are scattered dwarf birches, willows, small spruces, grasses of *Festuca*, *Poa*, and *Calamagrostis* genera, sedges, and a few ferns.

At Twelvemile Summit, about 85 miles northwest of Fairbanks at a still higher elevation (3,225 feet), a Tundra soil was observed that could be described as transitional between an Arctic Meadow and a Half Bog (fig. 25). It was examined on a gently sloping high ridge to the south of and above a steep slope where soil creeps were conspicuous. The Arctic plants of the tundra cover are fewer and more stunted than those found closer to timber line. They include sphagnum mosses, lichens, sedges, a dwarf *Ledum*, dwarf birch, and a prostrate willow. The yellowish-brown, slightly decomposed, mottled peat surface soil is about 5 inches thick. The subsoil consists of a light olive-brown, mottled with light yellowish-brown, wet and cold silt loam with a frozen layer beneath.

AGRICULTURAL DEVELOPMENT

In sheltered places a few small gardens are to be found, but no significant settlement may be expected under present economic conditions and with known farming methods.

CIRCLE AND HOT SPRINGS AREA

The Circle and Circle Hot Springs area borders the Tanana-Yukon upland to the east and northeast and extends east to the Yukon River. The distance across it along the Steece Highway east of the Miller house to Circle on the Yukon is about 40 miles. The area is a broad lowland plain. The part visited, between the Miller house, Circle Hot Springs, and Circle, includes low terraces to the southwest below the hills of the Yukon-Tanana upland, alluvial bottomland, and dunelike ridges to the northeast along the Yukon. Crazy Mountains lie to the north of the Steece Highway. Mertie (*19*) designates this area as a lowland of unconsolidated deposits of Pleistocene and Recent ages.

The road between the Miller house and Circle Hot Springs follows the low terrace. The land seen from the highway appears to be about equally divided between fairly well drained, poorly drained, and intermediate in drainage. One of the better drained soils may be described as follows:

It has a yellowish-brown raw peaty mat 3 to 5 inches thick underlain by a dark-brown humus soil about 1 inch thick. This lies upon a light yellowish-brown sandy clay loam. This layer is mottled with brown, yellowish brown, and dark gray, is moderately plastic, and is some 10 to 15 inches thick. It grades downward into grayer loam containing many more small stones. The predominant natural cover consists of spruce, both black and white, dwarf birch, dwarf heath shrubs, and mosses.

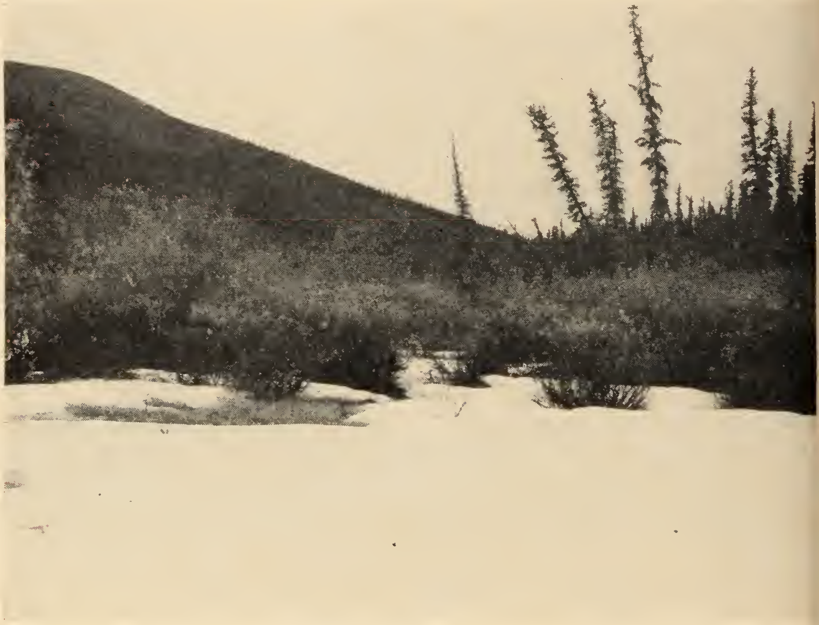

FIGURE 25.—A Tundra soil at Twelvemile Summit (elevation 3,225 feet), about 85 miles northwest of Fairbanks.

At Circle Hot Springs, in a little cove filled with alluvial materials, is a garden the soil of which is warmed by hot water in underground pipes fed from the hot springs (fig. 26). In the garden plot the dark-brown loam surface soil grades downward at 8 to 12 inches into a yellowish-brown loam. Some organic matter in the form of topsoil and compost has been added to the surface soil. The temperature of the soil 6 inches below the surface varied from 72° to 84° F.[5]

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[5] Data on the Circle and other hot springs are recorded in a water-supply paper by Waring (*26*).

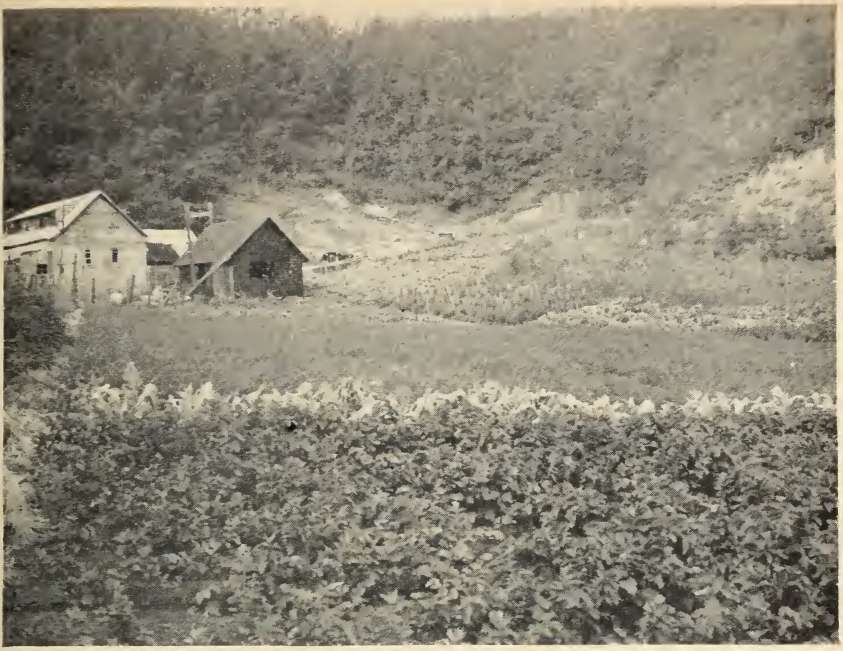

FIGURE 26.—The soil of this garden at Circle Hot Springs, in a little cove filled with alluvial material, is constantly warmed by hot water from the springs.

East of the Hot Springs Hotel on an undulating upland plain is a well-drained podzolic soil developed on what appears to be glacial drift. North of the hotel is an extensive lowland that extends northeast to Birch Creek, a distance of more than 17 miles. On this flat a Half Bog soil has developed. The soil was examined in a meadow of bluetop grass and sedges, which are cut for hay to be fed to saddle horses (fig. 27). A microrelief has low ridges and shallow depressions

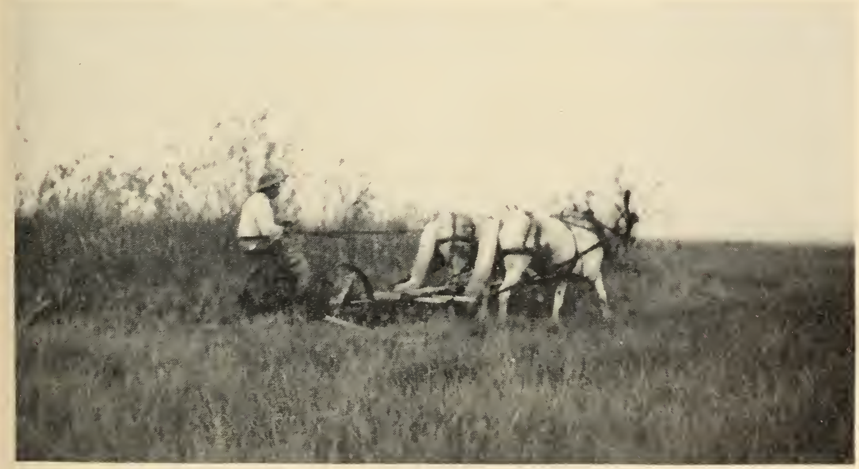

FIGURE 27.—Bluetop grass and sedges growing on the extensive lowland north of Circle Hot Springs are cut for hay, which is fed to saddle horses.

with differences in elevation of 1 foot or less. On the low ridges the soil has a weak-brown peat root mat 2 to 4 inches thick, underlain by a light olive-gray sandy clay loam, mottled with brown, yellowish brown, and dark brown. Frost was found at a depth of about 30 inches below the surface. In the shallow depressions the soil has a weak-brown fibrous sedge-peat surface soil 6 to 10 inches thick and a light olive-gray silt loam subsoil, slightly mottled with dark brown and yellowish brown.

At Circle the soil was examined in an old quackgrass hay meadow on the high bottom land west of the trading post and south of the banks of the Yukon River. It has a light grayish-brown loose loamy fine sand surface soil about 7 inches thick and a light yellowish-brown and light grayish-brown loose loamy fine sand subsoil.

AGRICULTURAL DEVELOPMENT

So far there has been little agricultural development in this area. Although there are considerable stretches of soil upon which crops could be grown, the low rainfall and frequent frosts are serious hazards, to say nothing of the long distances from markets or other important settlements.

BIG DELTA AREA

The Big Delta area occupies extensive terraces at the junction of the Alaskan and Richardson Highways. It extends about 35 miles southeast along the Alaskan Highway to a series of moraines, and south a shorter distance along the Richardson Highway. The terraces, wherever examined, consisted of a thick deposit of gravel and coarse sand well sorted by water. As seen from the highways the terraces break sharply and drop uniformly to lower terraces or bottom land. Such landscapes indicate coarse-textured terraces or benches. The native cover is a semiopen mixture of trees, grasses, and low-growing heath shrubs (fig. 28). The dominant trees are quaking aspen and spruce, the dominant dwarf shrubs are Labrador-tea and blueberry, and in most places bluetop is the most prominent grass.

The outstanding characteristics of the soil are its coarse-textured subsoil and substratum. At the Big Delta Military Camp the gravelly

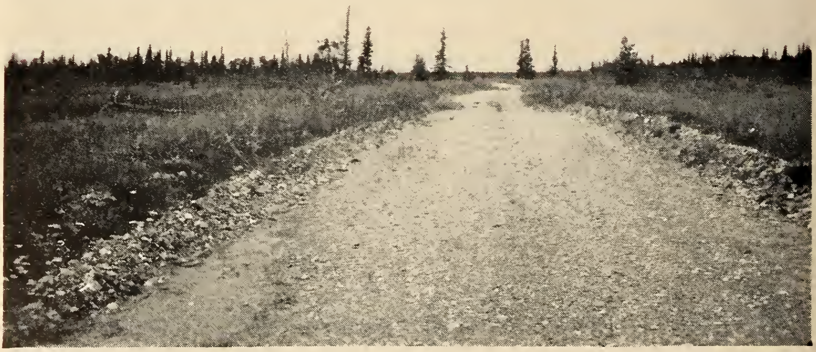

FIGURE 28.—View of Big Delta area showing the gravelly nature of the soil, shallow-rooted windfallen trees, and semiopen natural cover.

material below the soil contains less than 3 percent of particles smaller than 0.2 mm. in diameter. The soil examined at several places at this camp has a dark-brown or weak reddish-brown friable gravelly loam to gravelly sandy loam surface layer 6 to 10 inches thick, over a mixture of gravel and coarse sand. Along both highways the gravelly base is within 18 inches of the surface. Such a soil warms up early in spring, but growing crops suffer from lack of moisture.

The Big Delta has been mentioned repeatedly as a prospective grazing area because it now supports a herd of about 400 buffalo throughout the year.

KODIAK ISLAND

The exploratory party made a quick trip to the northeastern end of Kodiak Island, where they visited several points, including the village of Kodiak, the military base to the southeast, the valley of Buskin River, the flats at the head of Womens, Middle, and Kalsin Bays, and the upland ridges between these bays. In agricultural possibilities, northeastern Kodiak Island compares more favorably with the western Kenai Peninsula than do any of the outlying areas previously discussed. As in the Kenai district, grass crops are best adapted to the soils. Thus stock raising deserves greatest attention.

In northeastern Kodiak Island two distinct land forms stand out prominently: (1) The valley flats, which are the floodlands of the estuaries of several rivers at the head of the embayments; and (2) the grass-covered high ridges and mountains between them (fig. 29). Smith (*24*) identified the formations in this area as undifferentiated Mesozoic sedimentary rocks. The valleys are grass-covered except for clumps of spruce, alder, and willow trees, red-berried elder and salmonberry shrubs, cow-parsnips, and devilsclub.

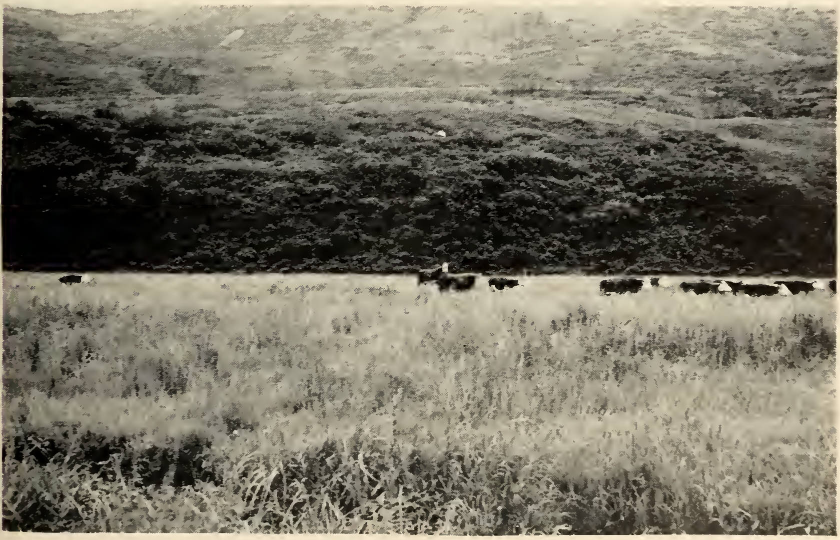

FIGURE 29.—This scene at the Felton Ranch at Middle Bay illustrates the two distinct land forms in northeastern Kodiak Island—the valley flats and the high ridges and mountains.

The valley of the Buskin River is considered typical of many valleys in northeastern Kodiak Island. The soil was examined near a garden plot on a gentle south-facing slope on the north shore of Buskin Lake. This garden, about 12 acres in size, was begun in 1942 by the Army and is now used by Navy personnel. At the time of the visit the garden crops were doing poorly; growth was below normal, and nearly all plants were chlorotic.

The outstanding characteristic of the soil here, as in nearly all the areas examined on Kodiak Island, is the surface cover of 6 to 12 inches of light-colored volcanic ash over the old surface soils. The surface soil is a reddish-gray to pale-yellow loose volcanic ash about 10 inches thick. The present subsoil, originally the surface soil before being covered by the volcanic ash, is a dark grayish-brown granular friable loam moderately high in organic matter.

North of the garden is an unplowed area under a rank growth of bluetop, fireweed, and lupines. The soil consists of a dark yellowish-brown root mat about 2 inches thick on the surface, beneath which is a yellowish-white loose fine or very fine sand, about 2 inches thick, filled with many grass roots. Below this is a pale yellow fine or very fine sand about 4 inches thick, which grades into a yellowish-gray loose fine sand in which can be found only an occasional root. These soil layers have developed in the volcanic ash deposited by Mount Katmai, on the Alaska Peninsula to the north, at the time of its eruption in 1912.

The lower layer, the original surface soil, is a dark grayish-brown granular loam 5 to 6 inches thick, grading below into a mottled-brown, light grayish-brown, and light olive-brown granular friable silt loam (fig. 30).

In the village of Kodiak excellent garden crops were grown before the deposition of the volcanic ash. Some of the gardeners have stripped off the ash and are using the underlying soil for gardens.

On both the Bell flat at Womens Bay and the flat at Middle Bay the soil consists of 10 to 12 inches of volcanic ash over an older soil developed from alluvial deposits on a tidal flat. Grasses and sedges grow rank. The surface 10 to 12 inches of soil material derived from the volcanic ash is a light grayish-brown weakly granular fine sandy loam. It contains numerous roots of grasses and sedges. The old surface soil, about 10 inches thick, consists of coarse granular moderately well-decomposed sedge and grass peat. The subsoil is a medium gray silty clay loam, mottled dark gray and dark grayish brown, massive, plastic, cold, and wet.

ALEUTIAN ISLANDS

The Aleutian group of small islands extends like a thin chain from the end of the Alaska Peninsula westward about 1,000 miles. Before the war a few thousand Aleuts in small villages were the principal residents. They lived mostly on fish but had some sheep and poultry. There has been a sheep ranch for some time near Chernofski Bay on the Island of Unalaska, and perhaps there are others. On the whole, agriculture has been insignificant in the Aleutians.

There are now several important military establishments all the way along the chain, several of which are still of considerable size,

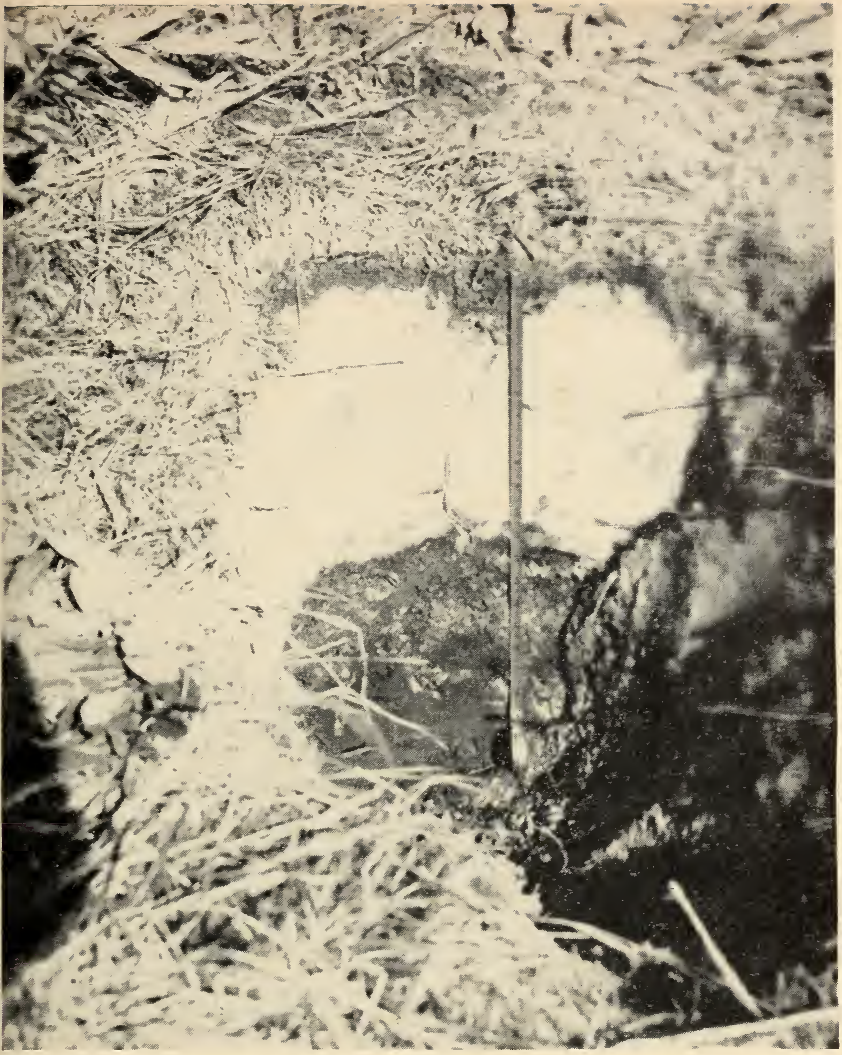

FIGURE 30.—The outstanding characteristic of nearly all soils examined in northeastern Kodiak Island was the surface cover of 6 to 12 inches of volcanic ash over the old surface soils. View of a soil profile north of Buskin Lake under a cover of bluetop grass, fireweed, and lupines.

Physiography.—The land is largely of volcanic origin, and some of the many volcanoes are still active. Essentially all the soil material is developed directly from volcanic cinders, volcanic ash, or other eruptive rocks, or has been reworked by local glaciers, flowing streams, beach erosion, or wind movement.

Many islands and parts of islands are steep and rugged down to the very water's edge. High peaks have perpetual ice and snow and even small glaciers. In other places are undulating upland plateaus, as on Umnak, and long gentle slopes to the sea. In a few places are low coastal beaches which coalesce with the stream valleys from the interior. Large basins in the interior are often filled with peat.

Different sorts of mounds are conspicuous on gentle slopes. Sometimes these are small, only 1 foot or so high and 2 to 4 feet across, but cover more than half the area, as near Cold Bay. In other places they are 3 to 6 feet high and 10 to 15 feet in diameter, but occur only one to 5 to 10 acres, as an Amchitka and Adak. Except on or near steep slopes, most of the land is moist, swampy, or at least imperfectly drained.

Climate.—On the whole the Aleutians are foggy, cold, wind-swept, and wet. At Cold Bay the temperatures are low enough in winter for the ground to freeze 2 to 4 feet deep, while near the end of the chain, at Shemya, it freezes no more than a few inches. Summer temperatures are low, generally under 60° F. Some stations report less than 2 percent of possible sunshine, with fog nearly half the time and many days with rain or snow. Driving winds are common.

Vegetation.—Except for the high peaks, steepest slopes, and bare rocks, a thick green carpet of vegetation covers the land. From a plane on a rare sunny day the land looks beautiful—like an excellent meadow. Except in a few places, however, grass is a relatively minor part of the cover. The vegetation consists predominantly of dwarf arctic shrubs, including crowberry, dwarf willow, dwarf birch, mosses, lichens, and various flowering plants. Some sedges and grasses are found nearly everywhere, and in a few places they are dominant in the vegetation. Only these places are suitable for hay and pasture. The only trees growing in the Aleutians are a few Sitka spruces planted long ago in the village of Unalaska.

SOILS

The soils are generally moist, dark-colored, covered with a peaty surface, cold (but not perpetually frozen), and developed from volcanic rocks or ejecta. Under conditions of comparatively good drainage, the following soil profile near Dutch Harbor is characteristic of a soil developed from volcanic ash:

(1) A_0. Brown peaty mat of roots, mosses, etc., 3 to 6 inches deep.

(2) A_1. Brown, mellow, softly granular silt loam containing many roots, 4 to 5 inches thick.

(3) B_1. Very dark-brown fairly granular silt loam with some roots. About 12 inches thick.

(4) B_2. Dark-brown heavy silt loam, compact in place but easily friable when removed. Some 20 inches thick.

(5) B_3. Transitional, yellowish-brown silt loam finely mottled with reddish-brown. Extends down to about 3 or 4 feet.

(6) C. Slightly reddish-brown loam, compact in place but easily dug out. Often there are layers of old soils buried by more recent volcanic ash.

The soil described would be suitable for grass and for hardy cool-season vegetables in sites not too steeply sloping and protected from the strong winds, but there are many variations. Usually the drainage is poorer; the soil is more nearly gray than brown and mottled with gray and reddish-brown. Many smooth areas and hillsides have a peaty covering of 1 foot to several feet, as at the main base on Shemya.

One may also find sandy soils on low dunes near the beaches. Disturbance of the native wild-rye grass cover during the war has exposed some of these to blowing, as on a few beaches at Shemya. Old beaches, now high and well-drained, are gravelly beneath.

The active volcanoes frequently cover old soils with ash and cinders, rejuvenating them and starting the formation of a new soil. The added layers may be thick, measured in feet, or they may be little more than dust films.

Native hay may be harvested or pastured wherever it grows naturally. Strongly sloping soils, wet soils, those with more than 1 foot of peat, very sandy soils, soils with seepy spots, and shallow soils over coarse gravel or rock should be avoided for any trials of vegetable crops. Any selected for use should be comparatively well-drained, gently sloping, near sea level but free from flooding, and protected from strong winds as much as possible.

A few notes on soil characteristics in locations studied follow:

Cold Bay.—No soils were seen suited to hay or pasture. In well-defined protected sites with a gentle slope a small garden might succeed, but the prospects are not good.

Adak.—Near the foot slopes of Mount Moffett, where a rifle range is located, is an alluvial valley that could rather easily be drained sufficiently to establish a hay meadow of considerable size. Pastures on the natural slopes are fair. A dairy herd of 15 to 20 cows might be supported in this area. On slopes having dark-colored surface soil and less than 1 foot of peaty surface, vegetable crops could probably be grown.

Amchitka.—No soils seen were well suited to hay or pasture. Some well-drained soils with less than 1 foot of peat may be found for a small garden, but the area is not promising.

Shemya.—No soils were seen significantly suited to hay or pasture. Narrow strips of well-drained soils between the peat swamps of the interior and the cliffs or the sand dunes near the sea might be used for vegetables. They would need protection from wind. Only small areas are available. The soil of the Aleut kitchen middens would be excellent, especially for use in greenhouses. Local seaweed could be used as a source of potash.

Umnak.—Large areas are available for vegetable gardens and hay meadows. For vegetables, the gently sloping well-drained land of the most protected places on the lower slopes should be used. At higher elevations the soil is too cold for vegetables but suitable for hay and pasture. Very little effort would be required to place several hundred to 2,000 acres near the base in shape to mow for hay.

Dutch Harbor.—Near the base is good soil for gardening. Much of it is too strongly sloping, and only the most smooth-lying well-drained deep soil should be used. Care must be taken to protect gardens on the lower slopes from wash from above by diversion terraces at a slight angle to the contour or by other appropriate means.

Unalaska.—At a distance, some suitable land was seen near the base and toward the west end of the island, near Chernofski Bay.

Other islands.—Tonaga, Atka, and other islands may be expected to have suitable soil, but these were not seen.

Fertilizers will unquestionably be required for vegetables and possibly for good-quality hay. Nitrate fertilizers are almost certainly needed for good early growth, and possibly phosphate and potash would also be needed. Something more specific can be said after soil and grass samples have been examined in the laboratory. Small-pot experiments with a large soil sample taken at Umnak will also be helpful. Lime may possibly be needed, but this cannot be decided until the samples of soil are studied.

Soil blowing on Shemya can be controlled by transplanting beach grass on critical areas, spaced 18 by 18 inches. Some mulch of hay or peat, held down by old fish nets, would be helpful where seedings are attempted with grasses such as brome and rye mixtures.

Trees may be planted on well-drained, protected sites, even on very sandy soils, if they are set out carefully and the soil is kept covered with a 2- or 3-inch layer of moss and peat. When set out in spring they should be given a cupful of mixed fertilizer, like 5–10–5, well mixed with the soil. A space of about 18 inches around each tree should be kept clear of grass and other plants while the trees are small and just getting started.

AGRICULTURAL DEVELOPMENT

Any significant development of stock raising or vegetable growing much beyond the present stock-raising enterprises will probably need to be heavily subsidized. Whether this is possible depends upon the importance of fresh milk and vegetables to American forces quartered on the islands. Enough suitable soil appears to be available if an attempt is decided upon, but it would take the most expert management to make sure of success.

FORTYMILE AREA

The Fortymile area, regarded by some as an area of agricultural possibilities, was not visited by any member of the exploratory party. Georgeson (*1*), after visiting the interior in 1900, first called attention to a tract of land of considerable size at Fortymile that appeared to be promising for farming. Information for Prospective Settlers in Alaska (*2*) mentions a comparatively large body of agricultural land along the South Fork of the Fortymile River. The area referred to as the South Fork lies along the Alaska-Canada boundary west of Dawson, Yukon Territory, and is made up of Dennison Fork, Mosquito Fork, and a stretch of land below the junction of the two.

Based on what was seen to the south of Fortymile along the Alaskan Highway and on information interpreted from maps and from two United States Geological Survey reports (*13*, *19*), it appears that the area has soils suited to agriculture. How extensive they are will remain unknown until a more detailed survey can be made. From climatic records at Eagle, a short distance to the north, it can be assumed that the climatic conditions are very similar to those near Fairbanks—typically subarctic and semiarid.

Mertie (*19*) designates the lower valleys in the Fortymile area as aggraded and refers to alluvial materials and terraces along streams. He points out that calcareous schists and limestones are more common there than in other areas of the Tanana-Yukon region of Alaska. He also reports the occurrence of lava and recent volcanic material. Hence it is probable that the alluvial materials may have been derived in part from a source different from those in the Tanana Valley near Fairbanks.

YUKON RIVER AND BETHEL AREAS

Members of the exploratory party visited parts of the Yukon River and Bethel areas on a boat trip from Tanana to Circle with a stop at the site of the former agricultural experiment station near Rampart. Another trip was made by plane from Fairbanks to Bethel, following the valley of the Kuskokwim River.

Along the Yukon below Circle two strips of land have been referred to as having agricultural possibilities. One is between Circle and Fort Yukon, the other from about Rampart to below Tanana at the confluence of the Yukon and Tanana Rivers. Oldroyd (2) reports that in the Kuskokwim and Yukon Valleys many thousand square miles of potential agricultural lands are capable of producing crops similar to those now being grown in the Tanana Valley. He further reports that results like those at Fairbanks were obtained at the agricultural experiment station at Rampart, on the Yukon. Vegetation on these two areas consists of a forest of spruce, poplar, and birch on higher ground and thickets of willow and alder in sloughs or on bars. The soil consists largely of silt loams to fine sands, becoming coarser with depth and underlain by gravel. Both these areas remain undeveloped and undoubtedly will remain so for a long time. The river is the principal route of travel. Land travel is difficult in summer, when the ground is wet; it is usually easier in winter. Between these two areas along the Yukon are lake-dotted marshy flats that are inundated during flood stages of the Yukon.

Bethel is situated at the mouth of the Kuskokwim River. Along nearby stream courses are wide bottoms covered with water. Tundra vegetation is found nearly everywhere—mosses, grasses, and sedges, with stunted willows. At the settlement of Bethel and in the immediate vicinity, bluetop grass predominates. The area is mostly swampy and generally unsuited for agricultural use.

Both the Yukon and Bethel areas are within the region of permanently frozen soil, but the soils do not remain permanently frozen within a distance of a few hundred feet from the river bank.

MISCELLANEOUS AREAS FOR SUBSISTENCE CROPS

Small areas of soil may be found throughout the Territory that are suitable for small gardens or individual farms. The areas with suitable soils may be only large enough for a tiny garden (fig. 26) or they may include several farms or ranches, as on some spots of alluvial bottom land (fig. 24). These areas are capable of producing food for people engaged in activities other than farming. The soils in these places vary widely but, in general, they are young, rather deep, nearly level or gently sloping, and moderately well drained. They are found in coves, lower valley slopes, alluvial bottom lands, deltas, former lake basins, and narrow coastal strips. They are rather productive or may have been made so by careful tillage and by the use of fertilizers, composts, and other amendments. Good gardens were observed throughout the Territory, often in nearly inaccessible places (fig. 31).

Small areas of soil suitable for gardens are rather abundant in southeastern Alaska. This part of the Territory consists mainly of mountains, and many of the valleys are occupied by glaciers (fig. 2, A). There is little level land. The narrow, level valley bottom lands, interspersed with many lakes, are usually wet. Soils are generally shallow and overlie bedrock except in the lower valleys, on talus slopes, in coves, and on some narrow coastal strips. The climate is characterized by mild winters, cool summers, and abundant precipitation.

A dense forest of tall trees and brushy undergrowth extends from tidewater up to about 2,000 feet. Although this is the most thickly

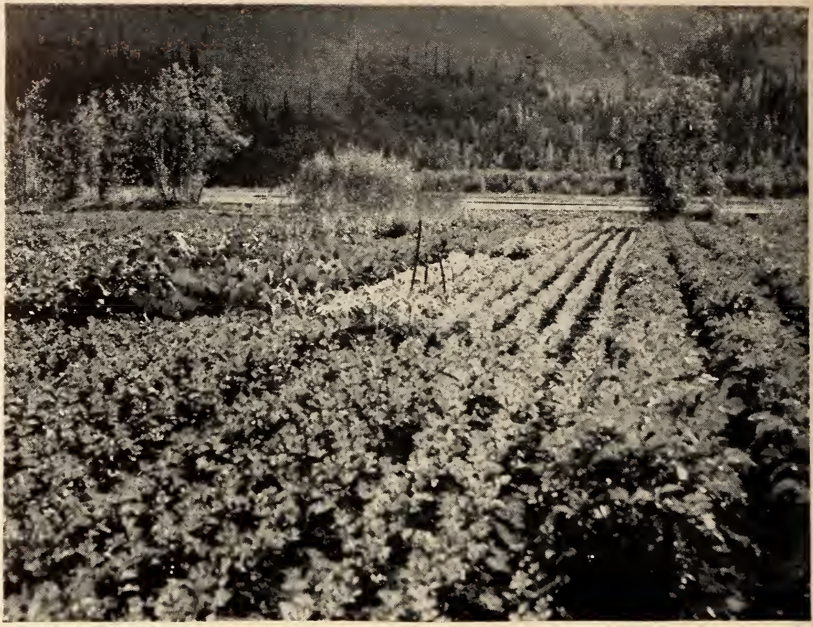

FIGURE 31.—There are good gardens throughout the Territory. This one is on soil derived from recent alluvium along the banks of Caribou Creek, some 2 miles south of the Glenn Highway.

populated area in Alaska, containing a third of the total population, it has little agricultural development. Land clearing is difficult and drainage is necessary before many fields can be chopped. The region is favorable for intensive vegetable gardening and some small fruits but not for grain growing. Near the towns there are many gardens and a few large meadows that produce forage for the limited number of livestock.

Juneau and the area in its immediate vicinity are representative of the communities in southeastern Alaska. The area is rich in recreational opportunities but not in agricultural land. During the war a victory-garden site large enough for the city, with soil suited for gardening, was worked several miles from the city on alluvial bottom land at the mouth of Salmon Creek (fig. 32). No suitable soil was available nearer to Juneau. The topsoil used for the gardens was hauled from a delta deposit near the mouth of Lemon Creek about 6 miles away.

On an area of several hundred acres of alluvial bottom land, on a narrow coastal strip, are five dairy farms. Here the soils are moderately well to imperfectly drained. The most prominent soil on these farms is a very friable, mottled light-gray and brown very fine sandy loam surface soil 6 to 10 inches thick, which breaks easily to a soft crumb structure, and a mottled light olive-gray and brown loamy fine sand subsoil slightly compact in place but loose when removed. Sitka spruce and alder were removed from the 30-acre field shown in figure 33, and the land was broken and seeded to timothy and clover. The cost of clearing and preparing this field for seeding was $7,000 in 1938.

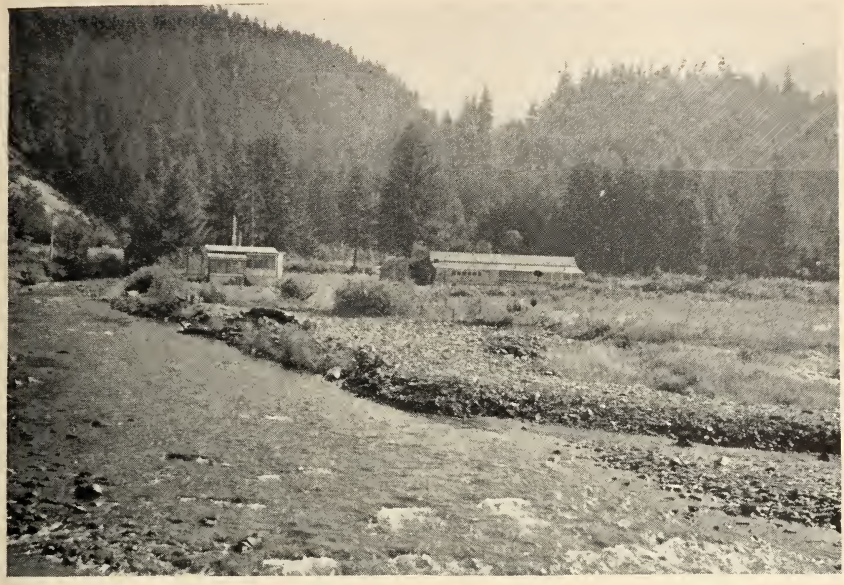

FIGURE 32.—A wartime victory garden large enough for the city of Juneau was located on alluvial bottom land near the mouth of Salmon Creek, several miles northwest of Juneau along Glacier Highway.

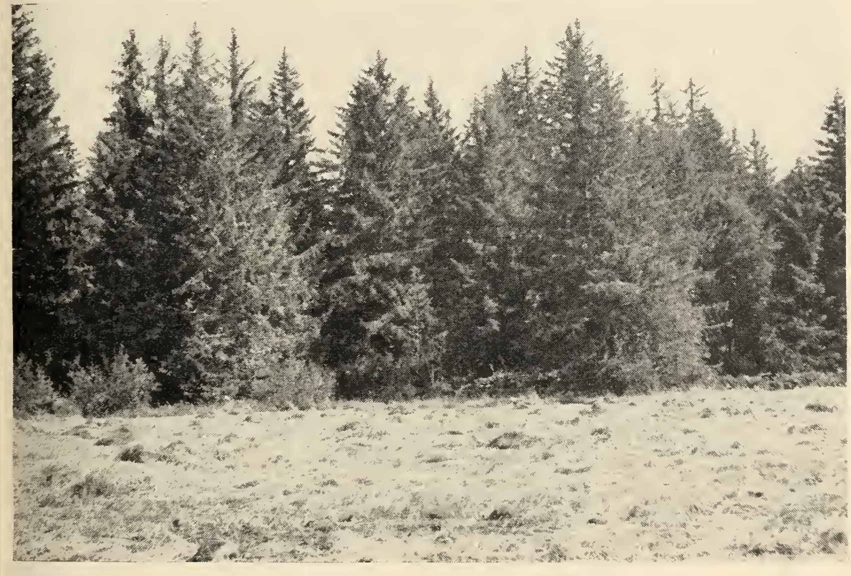

FIGURE 33.—Alluvial bottom land on a dairy farm near Juneau. In the foreground is part of a permanent meadow on land cleared and broken in 1938. In the background is a dense stand of Sitka spruce with an undergrowth of alder.

A typical upland soil with an 8-percent gradient is found along Glacier Highway, at Point Louise, northwest of Juneau. Its best use is in its present native forest cover. It supports tall hemlock and Sitka spruce, with a thick undergrowth of alder, red huckleberry, thimbleberry, goatsbeard, creeping raspberry, dwarf dogwood, ferns, and devilsclub. Its profile is as follows:

(1) A_0. Dark-brown fibrous leaf and root mat, 2 to 4 inches thick.

(2) A_1. Dusky-brown humus soil. About one-fourth inch thick.

(3) A_2. Reddish-gray loam (slightly mottled with grayish brown); weak fine platy structure; friable; many roots; a few pebbles; 5 to 7 inches thick.

(4) B_2. Dark-brown loam; weak blocky structure; many roots; many pebbles. The dark-brown color grades to a weaker brown in the lower part; 10 inches thick.

(5) B_3. Mottled light olive-gray and yellowish-brown sandy clay loam; few roots. This layer contains many coarse fragments of slat, quartzite, and schist; 8 inches thick.

(6) C. Broken rock.

PERMAFROST IN RELATION TO SOIL USE

Most of Alaska north of the Alaskan Range has a soil that, except for the surface, remains perpetually frozen to a depth of one to several hundred feet and never thaws out during the summer. This soil condition is known as permafrost.[6]

Permafrost is a field of study in itself, with applications in geology, engineering, and several other fields. Muller (*21*), in his report, "Permafrost or Permanently Frozen Ground and Related Engineering Problems," has compiled the work of many Russian scientists, citing 77 Russian, other European, and American publications.

The United States Army and the United States Geological Survey are sponsoring intensive and systematic researches into the nature and character of permafrost. Surveys of permafrost conditions are being conducted as a basis for locating and designing structures, and investigations bearing on the design of roads and buildings that can be maintained (will maintain themselves) over permafrost are under way. Interpretation of these data, as well as some special studies relating to specific farm problems, would be of great value to farmers in northern and central Alaska. Researches in this field in Russia, since the beginning of the century, have yielded high returns.

OBSERVATIONS ON SEASONAL DEPTH TO PERMAFROST

Above the permafrost, the soil thaws in summer and freezes again in winter. This layer is known as both the seasonally frozen soil and the active layer. The use that can be made of the soil is closely related to the thickness of the surface layer. In spring the soil thaws from the surface downward, and the depth to which it thaws early in spring and in summer affects its agricultural use. Since the permafrost layer is impervious, it retards drainage. Surface water has two avenues of escape, by evaporation and by surface run-off or lateral movement to lower elevations through the thawed soil above the frost line. Slow drainage delays the preparation of the seed bed and the warming of the surface soil in spring too much for proper germination of seeds and nitrification.

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[6] The expressions "permanently frozen ground," "ever frozen soil," and "ever frozen subsoil" also have been used. Most American workers in this field, including scientists and engineers of the U. S. Army and U. S. Geological Survey, now use the shorter term "permafrost."

Practical methods to improve drainage conditions would permit greater agricultural development in Alaska. Important factors influencing the thickness of the seasonally frozen soil include type of soil, especially as it relates to texture and content of organic matter, moisture content, exposure, vegetative cover, and snow cover.

Of soils examined in the vicinity of Fairbanks early in July 1946, it was observed that the unfrozen soil was consistently shallower under a thick insulating cover of native vegetation than where it was free of a vegetative cover. Yet the depths varied considerably within short distances, indicating that the frost table [7] is uneven. In Tanana very fine sandy loam, with a moderately dense stand of spruce, an undercover of dwarf shrubs, and a surface layer of sphagnum moss and sphagnum peat about 6 inches thick, the frost table was usually less than 18 inches below the surface. In contrast, in adjacent cultivated areas of the same soil type, the frost table was everywhere below 36 inches and generally deeper than 6 feet. Variations are even greater in Fairbanks very fine sandy loam.

In the vicinity of the air strip at Bettles, north of the Arctic Circle, most of the soils are classified as Half Bog. The depth of the frost table was measured on June 18 on six representative sites under the different kinds of native cover found. In four of the six sites examined, frozen soil was found at 36 inches or more below the surface.

At the first site the natural peat and moss cover of 1 foot had been removed. At the second site a caterpillar tractor had compacted the overlying moss and peat and reduced their insulating value. At the third, the native vegetation had been burned. The fourth site was in an aspen grove. At the fifth site, in a Half Bog soil (fig. 34) under a cover of mixed grasses, sedge, and dwarf shrubs, the frost table was 18 inches below the surface. At the sixth site the frozen soil was immediately beneath a cover of 4 inches of moss peat and 6 inches of sphagnum moss on which grew dwarf shrubs interspersed with scattered black spruce.

Capt. Homer Humphrey, of the Army Permafrost Laboratory, reported that the local inhabitants, when selecting a camp site, have learned to look for a place where aspens grow. He added that under these trees or other species of poplars, the frozen layer was generally 6 feet or more below the surface.

ICE IN PERMAFROST AREAS AND UNSTABLE SURFACE SOIL

In the vicinity of Fairbanks closer observations of the deeper substrata could be had in several valleys under placer strip-mining operations. The permafrost layer contains ice in solid masses as lenses, seams, veins, wedges, and blocks, interbedded with masses of silty and mucky soil material (fig. 35). Underground ice was observed most commonly at and below the poorly drained lower valley slopes under alder shrubs.

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[7] The surface that represents the upper boundary of the frost layer in the seasonal frozen soil is referred to as the frost table, by analogy with groundwater terminology. The surface that represents the lowest frost table, or upper boundary of the permafrost, has been called the permafrost table. As thaw proceeds downward late in summer and in fall, the frost table merges with the permafrost table.

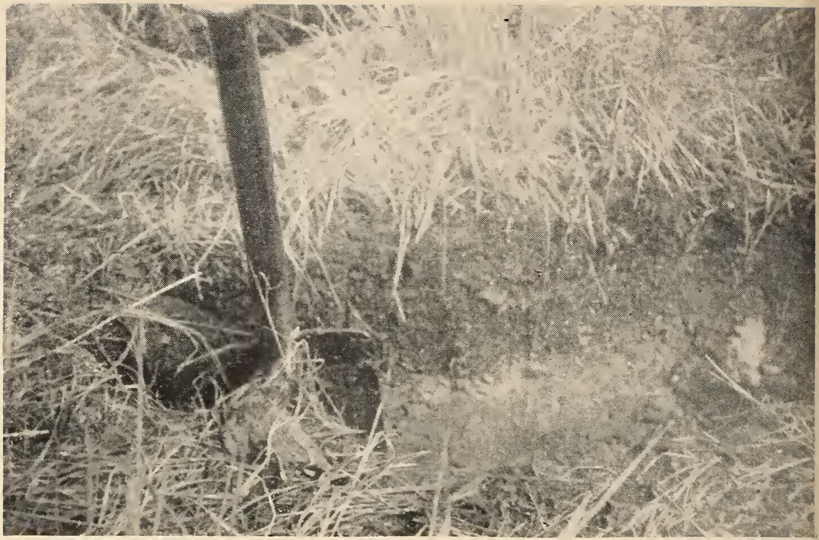

FIGURE 34.—View of a soil profile in the vicinity of the Bettles airstrip, classified as a Half Bog. Under a cover of grasses, sedges, and dwarf shrubs, the surface layer is peat, 9 inches thick, overlying a light olive-gray clay loam (Glei) horison, with the frost table 18 inches below the surface.

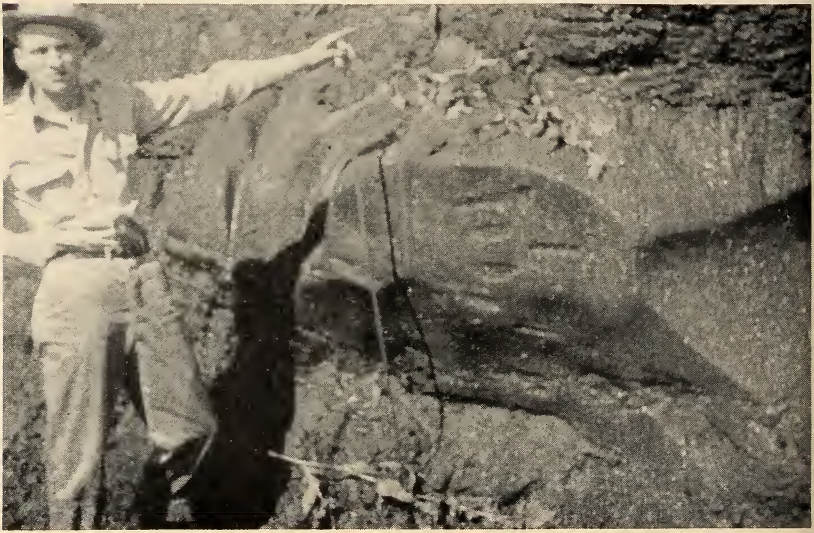

FIGURE 35.—Placer mining operations in the Fairbanks area permit closer observations of soil substrata. A block of ice in a fresh cut in permafrost at the upper end of Wolf Creek.

The quantity of ice in the frozen layers has an important bearing on the suitability of soils for farming. The thaw of this ice following clearing produces an unstable surface soil subject to settling and caving. Such settling was observed in a cleared field on the Fairbanks Agricultural Experiment Station (fig. 36). The history of this field, as reported by G. W. Gasser, formerly dean of agriculture at the University of Alaska, is as follows:

1908. Cleared of spruce and alder and then broken.
1909. First year cropped.
1918. First signs of surface soil settling.
1921. Field had become undulating (hummocky) but could be cultivated with difficulty.
1927. Several caverns and caves had formed, resulting in loss or damage to farm machinery. The field was then converted to pasture and has remained so since.

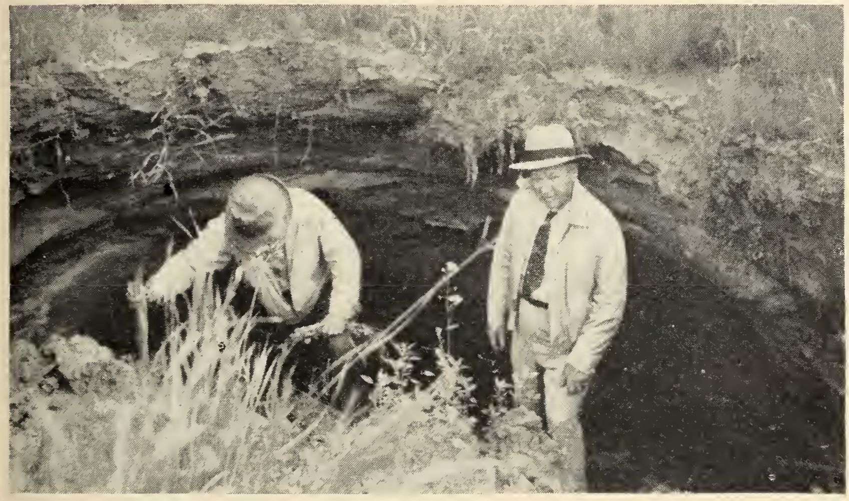

Figure 36.—Underground ice produces unstable surface soil when used for growing crops. A recently formed cavern in a once-cultivated field at the Fairbanks Agricultural Experiment Station.

Georgeson (*16*) in 1928 referred to a cleared field at Fairbanks where the ice in the substrata had melted irregularly, leaving an uneven surface. Rockie (*22*) has even referred to this condition, which he calls pitting, as a form of erosion.

AGRICULTURAL APPLICATIONS OF PERMAFROST RESEARCH

Through further study of permafrost conditions, it may be possible to develop principles to serve as reliable guides for avoiding areas subject to caving and settling after clearing for crops.

The presence of permafrost also greatly complicates the ground-water-supply situation and often makes it impossible for farmers to locate wells that have a dependable supply of satisfactory water. Often wells through permafrost will freeze, even in summer. Investigations of farm water supplies, especially in the Fairbanks area, are needed.

Thus the suitability of land for clearing, road and building location and construction, farm drainage, and farm water supply are strongly influenced in central and northern Alaska by the depth to permafrost and its nature and thickness.

SUPPLEMENTARY LABORATORY INVESTIGATIONS

Laboratory examinations have been made of some soil samples of representative soil types in Alaska collected in the summer of 1946. These were too few for definite predictions of fertilizer needs and responses, but the following generalizations can be accepted tentatively until further data are available:

1. Most of the soils are thin in the sense that the biological processes essential to true soil formation take place only in the upper 6 to 18 inches, even though fine mechanically weathered material may be several feet deep above coarse gravel or hard rock.
2. Surface-soil layers are naturally high in organic matter.
3. Because the lower part of the soils is ever-frozen, or at least quite cold, there has been little chemical or biological transformation of organic or inorganic materials below the surface layers of about 6 to 20 inches.
4. The amount of leaching of soluble materials varies greatly with climatic conditions. In the Matanuska Valley and Fairbanks area, for example, there is relatively little excess soil water to cause leaching. Leaching is high in soils having a big excess of water over evaporation and transpiration during periods when the soils are unfrozen.
5. Except for a very few soils developed from slack-water clays along the sea or large streams, the soils are unusually low in clay because of the small extent of chemical weathering. Even the silty soils of the Matanuska Valley are unusually low in clay for soils so rich in coarse silt and very fine sand.
6. The moist soils of the plains and hills, including those on the Aleutian Islands, which have highly organic surfaces (Half-Bog, Mountain Meadow, Tundra, and Mountain Tundra) are moderately to strongly acid throughout the root zone. Crops on soils of comparable acidity in the northern part of the United States respond to applications of lime. The soils of the Matanuska Valley are intermediate—slightly to medium acid—and some crops may respond to liming. The upland soils near Fairbanks and Copper Center are acid only in the very surface and are neutral to slightly alkaline in most of the root zone. All other soils examined are moderately acid.
7. Generally, the upland soils from the Matanuska Valley, the Fairbanks area, and Copper Center showed good calcium-magnesium ratios from the standpoint of crop production. The more acid soils, however, are low in available calcium.
8. Generally, exchangeable potassium is low (of the order of 0.1 to 0.3 milliequivalents per 100 grams of soil) and, according to experience in the northern part of the United States, most crops, especially vegetables, may be expected to respond to potash fertilizer. In the colder soils, like Tundra, and the highly organic soils, the exchangeable potassium is higher, but the total is low.
9. As expected, results for available phosphorus are quite variable. Nearly all soils showed, according to standards for the northern part of the United States, reasonably high amounts of available phosphorus in the immediate surface (except for some of the highly organic surface layers of Half Bog, Tundra, Mountain Meadow, and Mountain Tundra). But in many instances the amounts in the underlying soil

were very low indeed. It appears likely that the bulk of the available phosphorus in most soils in Alaska is tied up with the organic matter. Where this has been destroyed in land clearing, the cultivated soils are likely to contain too little for satisfactory crop production. Likely most soils in Alaska will need phosphatic fertilizers for optimum yields of crops, especially if other factors responsible for high yields are also properly adjusted.

10. No very useful generalizations can be made yet about the minor nutrients. Nothing has been discovered yet to suggest extremes in composition, except that manganese is known to be low and deficiencies may be expected, especially as the other nutrients are supplied in fertilizer. The preliminary data suggest that minor elements, like available phosphorus, may be tied up considerably with the organic matter.

11. The laboratory data now available serve to emphasize further the inferences made from the field observations that the conservation of organic matter in land clearing and tillage is of enormous importance to soil productivity in Alaska—probably even more so than in temperate regions. Even in soils where the organic layers are acid and low in plant nutrients, the organic matter serves to protect the soil from blowing and washing.

IMPORTANT SOIL PROBLEMS IN ALASKA

This summary statement of the important soil problems of Alaska is presented from the point of view of research needs in relation to the present agriculture and its reasonable expansion through settlement in the years immediately ahead. Any division between soils suitable for cultivation, on the one hand, and those unsuitable, on the other, is more or less arbitrary. The distinction depends, of course, upon accurate knowledge of the soils. Such knowledge is still not available for much of the Territory—we have it for only a few tiny sample areas. Further, the distinction depends upon the state of the agricultural arts at the moment. New discoveries and methods often change the relative advantage of different soil types. Finally, and perhaps most important, the distinction depends upon the general economic outlook, and more especially upon the prospective prices and costs of farm products and supplies.

Differences among the several areas have been pointed out; they need emphasis. But there are also important similarities. Hardy short-season vegetable crops are needed, and indeed are being produced in most parts of the Territory. But their adaptability and management requirements vary widely in the different areas and on different soil types within the same area. One cannot simply follow the methods used in some other place. Many failures have been due to a farmer's inability to discover in time the particular methods adapted to his new home.

Furthermore, most soils in Alaska do not give the best results when first broken and plowed. They are better after a few years of cropping. For good yields, fertilizers are generally needed from the start, especially nitrogen, potassium, and phosphorus.

In all thinking about soil-plant relationships in Alaska, one must continually keep in mind the shallowness of the true soil solum, regardless of the total depth of fine material; the youth of many of the soils; the mellowness of the surface soil; the low temperatures of the soil a few inches beneath the surface, whether frozen or not; the shallowness of roots; the great importance of soil organic matter; and the need for *rapid* warming for early nutrient supply. The contrast in soil climate and environment between virgin and cultivated soils of the same type can scarcely be overemphasized.

It is clear that a useful soil-research program for Alaska is not simply one of trial and error, as used up to the present by most farmers and experimental workers in Alaska, but one aimed at the basic problems of soil nature and use, which underlie failure or success.

The initial research program should include soil classification and mapping, carried on concurrently with investigations of crop adaptability and soil-management requirements, in the two, or perhaps four, areas where there has been some farm experience and where agriculture appears to have the best chance for success. The Tanana Valley near Fairbanks and the Matanuska Valley near Palmer are most important. Next consideration should be given the part-time farming area near Anchorage and the western Kenai Peninsula.

Results from these researches would have considerable general application, after which research could be more effectively and economically extended to other potential areas as need arises.

SOIL CLASSIFICATION AND MAPPING

Soil classification needs to be detailed in order to reflect the important variations in soils significant to crop adaptability and the management practices in this area, where fields are small. Detailed soil mapping with aerial photographs, on a scale of about 3 to 4 inches to the mile, should begin in the most highly developed agricultural areas, especially near Palmer [8] and Fairbanks and perhaps near Anchorage and Homer.

During the initial period the classification needs to be worked out with detailed morphological and laboratory studies, and especially with careful analyses of farmer experience, along with such results as are available from previous research.

As this work begins, a study needs to be made of the experience that farmers have had with fertilizers, lime, crop rotations, erosion control, and other practices. At least some simple but very important plot work can be arranged for on farms that represent the principal soil types. It is highly important that the work be begun in the settled areas, where enough data will be available from farm analyses to characterize the responsiveness of the soils to management. With the classification thus developed, the mapping work can be extended to undeveloped areas, and safe predictions can be made of their potentialities and of their management requirements.

A rough estimate of the acreage urgently needing detailed soil study and mapping is as follows: Matanuska Valley, 90,000 acres; Tanana Valley near Fairbanks, 60,000 acres; western Kenai, 35,000 acres; and near Anchorage, 7,000 acres. In addition, some schematic soil classification and mapping will be necessary on which to base preliminary judgment as to the suitability of other areas and to guide future detailed surveys.

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[8] The maps of the Palmer area made some time ago by the Soil Conservation Service will be of some value. Present classification and mapping, however, are inadequate as a basis for recommendations to farmers regarding their individual soil-management problems.

For optimum production most soils in Alaska require fertilizers from the start. Most farmers, including practically all those growing vegetables and potatoes, now use commercial fertilizers containing phosphate, potash, and nitrogen, but they have only the vaguest notions as to the proper ratios and quantities of such fertilizers for the various soils and crops. There is now a great waste of labor and material from using inadequate quantities of fertilizers or wrong mixtures. Time and method of application, in relation to various cropping systems, are also very important.

Use of lime needs to be investigated, especially in the Matanuska Valley. It is likely that some of the minor elements are necessary for optimum production.

Particular emphasis needs to be given to studies of the use of nitrogen, because either a deficiency or an excess has an extreme effect on both yield and quality of crops.

Unfortunately, most of the many soil samples collected by the exploratory party were held up by the shipping tie-up of the fall of 1946. A few collected from the Tanana Valley and examined in the laboratory appear to have ample supplies of plant nutrients except for available nitrogen and potash.

The soils sampled would appear not to need lime or more than light applications of phosphates. Such laboratory results, however, need to be checked by field trials. But certainly these soils have not been so strongly leached as similar soils in the northern Lake States or New England. (It is expected that some laboratory data will be available later.)

PLANT QUALITY IN RELATION TO SOIL CONDITION

The research on soils needs to be buttressed with studies of the quality of vegetable crops, feed crops, and grasses in relation to soil type and to management practices, especially to those dealing with fertilizers and the use of organic matter. Preliminary data on a few samples indicate wide differences in protein and mineral content of the same species under different soil conditions.

TILLAGE AND LAND CLEARING

Great possibilities exist for improving the effectiveness of tillage and land clearing and for reducing costs. Research needs to be conducted cooperatively with farm-management experts and with agricultural engineers, since the cost factor depends so much on the system of farming and the relations between the several enterprises.

The soil phases of such investigations are especially important in Alaska because of the effects of land-clearing and tillage methods on the organic matter. Already a good deal of soil has been badly damaged through land clearing that removed and destroyed the very valuable organic matter lying on the surface of the virgin soils and incorporated in the surface horizons. The tillage practices influence the organic matter and have a pronounced effect on the warming of the soil in spring and on its susceptibility to both erosion and soil blowing.

Seedbed preparation is especially important in the subarctic. Depth of planting, time of seeding, weeding, and cultivation also are closely related to tillage.

CROP ROTATIONS

Few farmers in Alaska follow regular crop rotations, partly because they have been able to grow so few good legumes. In the observational plots at the Alaska Agricultural Experiment Station are excellent stands of perennial vetch, yellow-flowered alfalfa, and Siberian red clover. Agronomists will need to tackle the problem of seed production. According to the farmers, late-winter and early-spring heaving of these plants raises a serious problem. The use of cover crops is complicated by their retarding influence on the rate of soil warming in spring. The weed problem is very serious and becoming worse.

All these problems, and others, need to be studied in order to develop practical crop rotations under which organic matter may be conserved, weeds controlled, and soil structure maintained against erosion and blowing, and so that the dairy farmers and general farmers may have good legume hays available.

ORGANIC MATTER AND COMPOST

In Alaska the maintenance of organic matter in the soils is both necessary and difficult. Most of the soils suitable for agriculture contain rather large quantities of organic matter, provided the surface mat and surface soil horizons (horizons A_{00}, A_0, and A_1) are carefully preserved during the process of land clearing. It appears that crops growing in the old windrows are much superior to the other crops in yield and quality. This may be because of (1) availability of more organic matter, (2) deeper soil surface (A_1) horizons, and (3) the presence of the ash from burning. Manure is available on the dairy farms, of course, although many of the farmers do not understand the importance of its preservation and use. But entirely inadequate supplies are available on vegetable farms and for the numerous rural and urban gardens.

Work is badly needed on the use of peat in lieu of manure and the use of compost made from green plants and peat. Most of the peat in Alaska is rather aw, but there are areas of dark-colored, well-decomposed peat, merging on muck, that might be used to great advantage. The preparation and use of compost is especially important near Anchorage and on gardens and truck farms throughout the Territory.

DRAINAGE

Many of the soils otherwise suitable for farming are imperfectly or poorly drained. In fact, most of the good soils in the Matanuska Valley give an initial impression of imperfect drainage but turn out to be suitably drained naturally when cleared. In the Tanana Valley many of the low terraces are a little too poorly drained for crop production, even when cleared. Some exploratory investigations to learn how these soils may be drained should be undertaken and, if promising, this work should be followed by more detailed study. In the Tanana Valley the problem of drainage is complicated with permafrost.

IRRIGATION

In the main agricultural areas mentioned, rainfall is relatively light and some irrigation would be of great advantage to vegetable growers. Several of them have installed sprinkler systems, but they have had no guidance. Both vegetable growers and gardeners need some help on this point, especially as to types of irrigation and times of irrigating.

SOIL EROSION

Erosion is not a critical problem on much of the land at present occupied or soon likely to be, but it is a serious problem on part of it. The hazard is there on cultivated slopes of 3 to 5 percent, depending on length of slope and type of soil, and more especially on cultivated steeper soils. This hazard is particularly great in spring before the lower soil has thawed out. On some of the more strongly sloping land now used for crops along the northern boundaries of the agricultural community near Fairbanks, the problem deserves careful attention.

Contour cultivation might help, but more than that is probably needed. Some farmers have installed terraces, but with mixed results. Often the construction of the terraces buries too much good surface soil, the terrace channels get blocked with ice, as in the northern Lake States, and gullies are started. Some experimental work is needed for suggesting the proper method of tillage on these sloping soils and the proper construction and spacing of terraces or hillside ditches, or both. As the soils become a little more depleted in organic matter and as settlers push on to the more sloping lands, this problem should increase in significance.

A special type of erosion hazard is caused by the melting of ice blocks in the permafrost. Often gullies are formed which superficially resemble ordinary gullies but from which there is no deposition. Experimental work is needed to discover ways to assess this hazard in new land and to control the gullies as much as possible when they form.

In a few places, especially along the Matanuska River, stream-bank cutting is a hazard to good farm land.

PERMAFROST

In the Fairbanks area of the Tanana Valley, as well as in many other places where some gardening and some farming might be undertaken, the lower soil is permanently frozen at depths varying from a few inches to many feet, depending on the natural vegetation, the previous and present exposure of the land, and the geologic history of the land during the period of glaciation.

Occasionally fields are cleared and used for crops for a few years and then become unusable for cultivation because of the gradual melting of ice blocks in the permafrost as a result of the increased temperature of the soil after clearing. Permafrost also raises difficulties with wells and with the construction of buildings.

The Army and the Geological Survey are sponsoring intensive researches on the nature and character of permafrost and on designs of roads and buildings that can be maintained over permafrost. This research now appears to be in good hands, and the men in charge would be only too glad to assist in making interpretations of their data available to farmers. Later on some special studies by soil scientists concerned with agriculture may be necessary, especially in relation to gully formation and the deformation of cleared fields.

SOIL BLOWING

In the Matanuska Valley and in certain other places, extremely strong winds produce a hazard from soil blowing. There is practically no wind in the Tanana Valley, but strong winds come out of the Matanuska Valley in winter and from the Knik glacier in spring. Unprotected and exposed soil in the path of these winds may be moved about.

Where the soil is on a series of relatively short strong slopes, as is frequently the case, much of it may be blown away from exposed places, especially where land lies bare awaiting spring planting of vegetable crops. In such situations the organic matter of the soil and the tillage practices followed are important considerations. Leaving the native forest on strips of uncleared land serves to break the winds where the hazard is significant. A soil survey showing variations in soil slope would be useful in assessing these hazards.

Research on tillage methods and crop rotations in the Matanuska Valley, and in other places where soil blowing is a hazard, should take this factor into account. The spacing and effectiveness of windbreaks need attention.

SPECIAL STUDIES NEAR MILITARY CAMPS

In various parts of Alaska, including the far north and especially the Aleutian Islands, are important military installations, in some of which several thousand men are stationed. Although farm conditions are far from ideal at some of these places, vegetables could be grown in combinations of field gardens, cold frames, and greenhouses. Nothing is known about the fertilizer requirements and other practices for producing vegetables on these soils.

In some instances dairy herds might be maintained on local pasture and local supplies of hay. Although the products raised would be costly, perhaps considerably above the market prices in the main cities of Alaska, the importance of fresh milk and fresh vegetables to these camps could easily be great enough to offset the increased cost. The practicality of such studies may be measured by their influence in maintaining troop morale.

OTHER RESEARCH RELATED TO SOILS

In addition to the items outlined above, which fall primarily in the field of soil science, others should be carried on because of their direct bearing on soil use. Besides those falling definitely in agronomy, horticulture, animal husbandry, agricultural engineering, and other fields of research carried on extensively in the Agricultural Research Administration, the following deserve mention:

1. Farm-management research is urgently needed in order to establish the economic results from alternative farm practices and combinations of farm practices. Since the chief source of knowledge will be the experience of existing farmers, careful farm-budget analyses are urgently needed. This work should be closely associated with projects in soil classification and soil fertility.

2. At the proper stage, probably not at the beginning, attention needs to be given to long-range land-use planning from the standpoint of rural zoning, group settlement, road placement, and the distribution of other social services.

3. Ground-water research is badly needed in the sloping land of the Tanana Valley. Several farmers are having extreme difficulty in obtaining suitable wells at reasonable cost. (The Geological Survey could be asked to look into this matter.)

4. The control of the Matanuska River to prevent serious damage to adjacent farm lands needs attention. This is a broad, rapid stream with several deep shifting channels. Engineering studies and works will be needed for holding these streams in proper channels within the broad river bed where they flow past good farm land.

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Report on Exploratory Investigations of Agricultural Problems of Alaska

Chapter 3. Cereal, Forage, and Range Problems and Possibilities in Alaska

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The soil areas in Alaska where field crops can be produced successfully and efficiently are small and scattered. Out of a total of approximately 370 million acres in the Territory, only about 1 million is suitable for farm land. Not more than 10,000 acres is being farmed at the present time. There is enough land suitable for general farming to meet the needs for some time to come.

A good many successful farms have been in operation in Alaska for many years. The operators of these farms have learned the potentialities and understand most of the limitations imposed by the climate and soil. In the principal farming areas—Matanuska Valley around Palmer, Tanana Valley around Fairbanks, and scattered coastal areas along the Kenai Peninsula—agriculture consists chiefly of dairying and the production of potatoes and vegetables on a small scale.

Although a limited export trade in a few agricultural specialities may develop, farmers will need to depend primarily on local markets. This means they will need to produce the kinds of products required by the people living in Alaska, who are engaged in mining, fishing, forestry, hunting, transportation, and communications. The rapidly expanding tourist trade will also be an important factor when facilities become available. An auxiliary type of agriculture will probably develop to service these industries and activities. The primary cash crop, potatoes, has been expanded sufficiently to take care of most of Alaska's present requirements. Mixed livestock farming with dairy cattle, hogs, poultry, sheep, goats, and beef cattle is important in the Matanuska Valley. If Alaskan agriculture is to continue and expand, livestock must occupy a greater part in farming operations in the future. A steady expansion in the acreage of cleared land is essential for the production of feed and for soil-improving crops.

CEREAL CROPS

WHEAT

A number of well-adapted varieties of cereal crops are available in Alaska (fig. 37). At the Fairbanks Station, Siberian No. 1 spring wheat was introducd in 1913 and selected out by Prof. G. W. Gasser of the University of Alaska. Kjute is a good variety from Finland. Several new selections from Minnesota did very well in 1946. The performance of this variety in the far North is surprising. A large acreage has been developed in the Peace River area of northern Alberta and British Columbia. Though it looked too late, it headed out only two days later than Siberian No. 1.

The main type of wheat grown by the farmers in the Fairbanks area is the Siberian or Chogot variety, a spring wheat; winter wheat

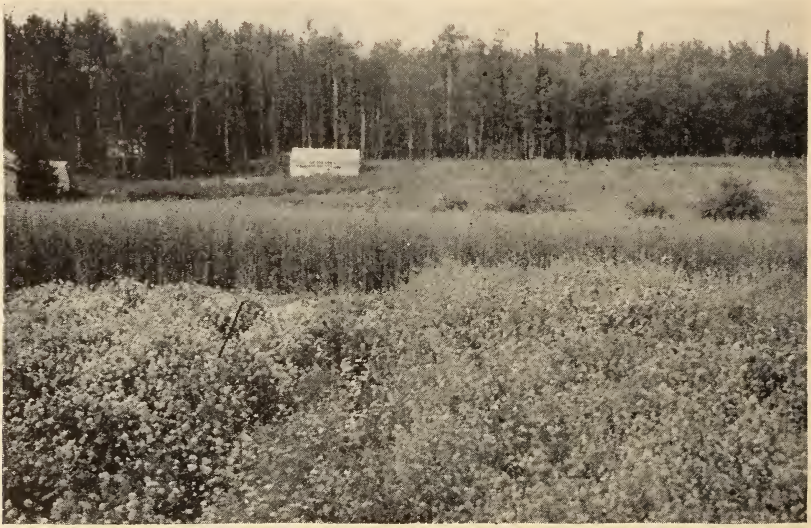

Figure 37.—Well-headed stand of wheat in middle ground, behind a field of Dutch white clover (left) and yellow-flowered Siberian alfalfa (right), both in full bloom. Fairbanks Experiment Station.

varieties are usually not grown. The grain is used chiefly as feed for cows, hogs, and poultry. It serves as a good substitute for corn. Many people use wheat as a cereal, either ground or whole, or make bread from the sifted flour. Wheat is seeded at the rate of about 80 pounds per acre, and the yield is increased in both quality and quantity by the application of commercial fertilizer. Average yields of about 22 bushels per acre may be expected under good farming practices.

In the fall of 1946, Siberian No. 1 wheat was the only variety that could be considered mature at the time of harvest. Dr. Basil M. Bensin, agronomist at the Fairbanks Station, has been advocating a system of harvesting at what he calls "harvest maturity," which is 10 to 12 days ahead of full maturity. When cut at this stage the grain shrivels some but dries and stores well, and the seed germinates the next spring. The system seems to be logical under the extremely limiting climatic conditions, and samples of grain seemed to support his contentions. Small grain fertilized with nitrogen, phosphorus, and potassium was too late in maturing to produce a crop.

The old Siberian No. 1 wheat is grown primarily for poultry feed. At one time there was a flour mill at Fairbanks, but there is no possibility at present of growing enough wheat in the area to more than supply the poultry needs. Consideration has been given to building a 100,000-barrel mill at Anchorage, but there appears to be little possibility of obtaining supplies for such a mill in Alaska. Most of the farmers grow wheat only for their own use. It is estimated that it would take about 15,000 acres to supply a 100,000-barrel mill. There are only 8,000 acres under the plow in the whole Matanuska Valley at the present time.

At the Pine Creek Experiment Station in the Canadian Yukon area, Garnet and Reward wheats appeared to be the best adapted and were practically mature in early September when the station was visited. Thatcher looked very productive but was too late in 1946. Siberian No. 1 from Alaska was not included in the tests.

BARLEY AND OATS

Both hull-less and hulled varieties of barley are grown. One of the best available adapted varieties for the Fairbanks area is the hooded, hull-less B19, preferred by many farmers for livestock feeding. It makes an excellent substitute for corn. Other varieties grown are White Hull-less and Manchurian. The seeding rate is about 80 pounds per acre, and average yields of about 23 bushels per acre may be expected. The standard barley variety in the past has been B19, a hooded, erect type. In observational plot tests Olli appeared to be the best adapted early variety. Newal barley, a smooth-awned variety from Alberta, and some of the new Finnish barleys also look promising.

At the Matanuska Station the small-grain test plots were rod rows with small increase plots of "standard" varieties. Uncertainty prevails over which varieties should be recommended. Since the station has little experimental evidence regarding the best varieties, it is probably to be expected that the farmers will take anything sent them from the Seattle seedhouses. The present program should provide information of value in the near future. No. B19 hooded barley distributed by the Fairbanks Station years ago is one of the poorest varieties in the Matanuska test nursery. Velvon, Newal, and Peatland are far superior and quite outstanding, as is Olli in a good season. The rough awns of Peatland and Olli make them less suitable, however, since all the barley is used for feed. The new introductions of Siberian barleys Nos. 1a and 5 looked very promising.

At the Pine Creek Station in Canada, the barleys were mature and being harvested when seen in 1946. Prospect and Olli varieties appeared the best, with Newal next, and then Titan. Velvon, which looked so promising at the Matanuska Station, was not included in the test.

Oats are grown mainly for silage and green bundle feeds (fig. 38, *A* and *B*). As a grain crop oats are not as well adapted to Alaska

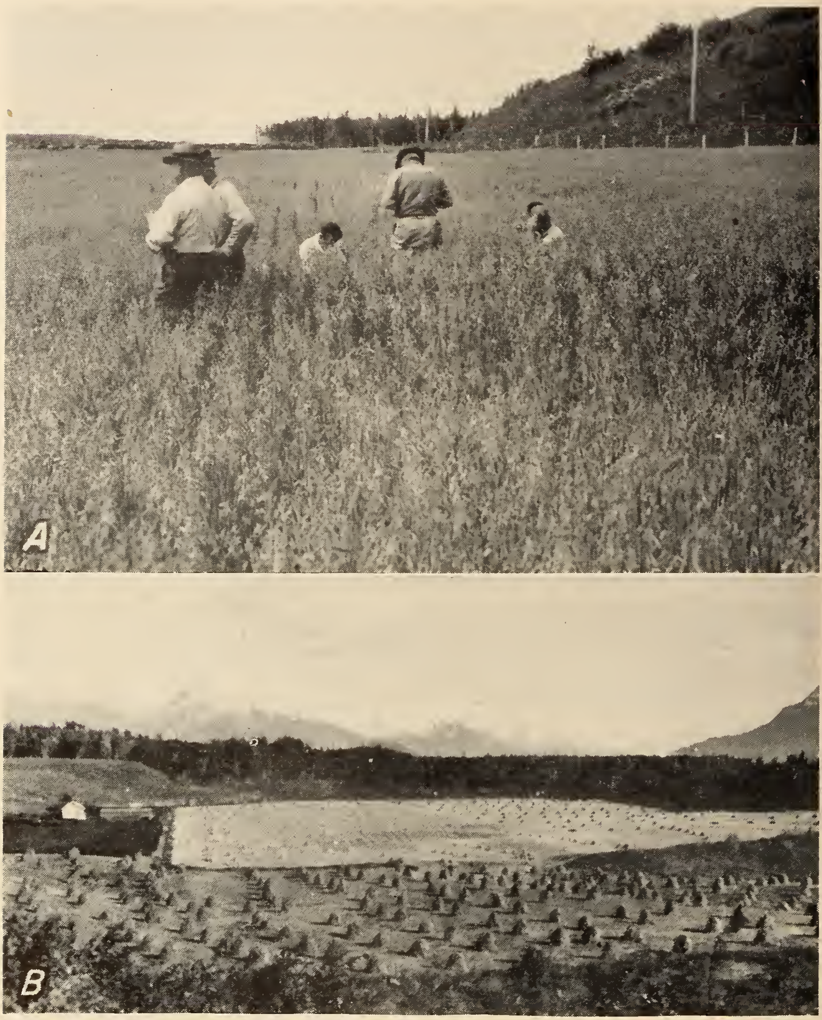

FIGURE 38. *A*, Taking samples from a good spot in an oat field on the Folk farm north of Bodenburg Butte; *B*, cocked oat-pea hay drying on stakes; shocked grain, forests, and mountains in the background. Matanuska Valley.

as wheat and barley. Clinton and Vicland oats appear the best of the limited plantings in the observation plots. The seeding rate when grown for grain is 75 to 100 pounds per acre. The application of 100 pounds per acre of treble superphosphate is considered profitable by farmers. Average yields of about 45 bushels of grain per acre are obtained.

Climax and Swedish Select seem to be the best varieties of oats at Palmer. A newly introduced Alaska Hull-less oat was outstanding in yield in 1945 and looked very fine in the field in 1946.

GRAZING DISTRICTS AND FORAGE RESOURCES OF ALASKA

Native grasses and many other range forage plants are widely distributed in Alaska, even north of the Arctic Circle. Grasses occur sparingly in the vast stretches of sedge-dominated tundra in northern and northwestern districts, becoming successively thicker and more thrifty from the Arctic Circle southward and from higher to lower elevations. Native grasses make quick growth and mature early, but they deteriorate rapidly with the advance of the growing season. Cutting or pasturing the native grasses year after year quickly depletes the stand. Overgrazing kills all the plants and starts wind and water erosion of the soil.

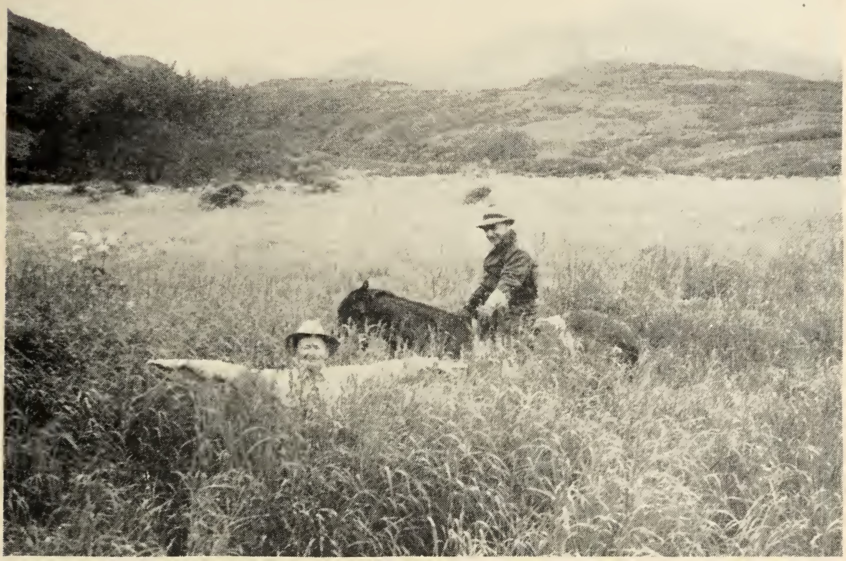

FIGURE 39.—Shoulder-high bluetop, the principal native grass of Alaska, on Sitkalidak Island.

The grasses grow surprisingly fast, tall, and vigorously on nearly all open areas of well-drained or partially drained soils (fig. 39), but a dense covering of other vegetation often insulates and holds the permanent ice layer or cold soil zone near the surface and retards grass development.

Much of Alaska is covered with tundra, forests, swamps, or perpetual snow (fig. 40). Consequently, extensive areas of open grass-

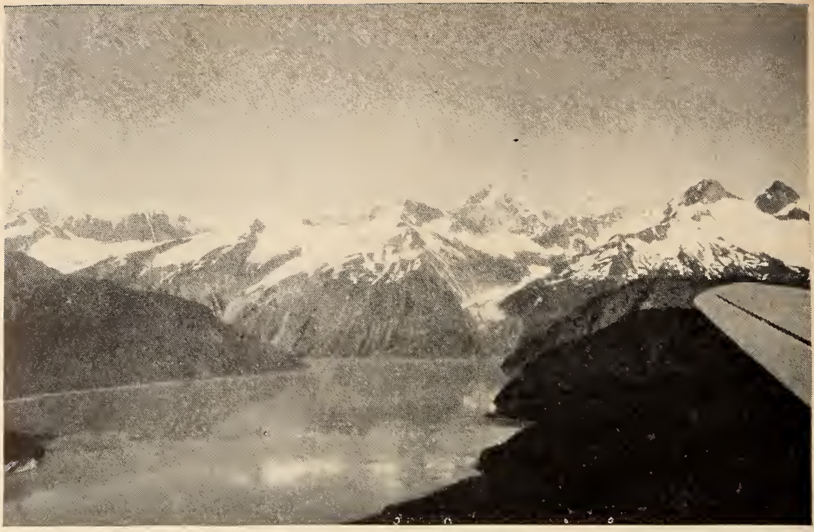

FIGURE 40.—Mount Crillon, Mount LaParouse, and Lituya Bay typify the rugged glacial terrain that borders the Gulf of Alaska and contrasts sharply with immediate adjacent areas of forest and other rank-growing vegetation. Alaska possesses several of the highest mountains in North America. The snowfall is much lighter and glaciers are less numerous in northern Alaska than in central and southern Alaska.

land are limited principally to the southwestern islands, parts of the Kenai Peninsula, and burned-over areas on the mainland. However, native grasses increase rapidly and thrive wherever the trees are removed or the tundra is disturbed on the better drained soils (fig. 41). Nearly every clearing, homesite, trail, railroad, highway, or airport

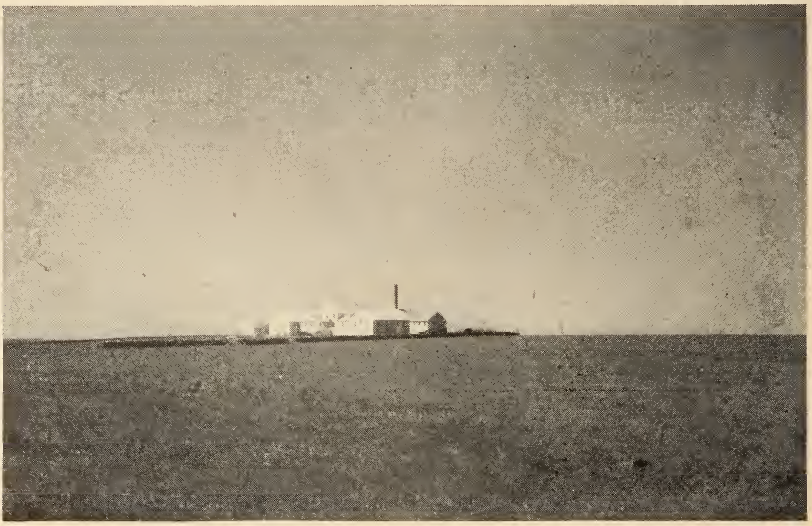

FIGURE 41.—Settlement activities near the Moravian hospital at Bethel have stimulated grass development on the treeless tundra.

in the Territory is bordered with a rank growth of native grasses and fireweed. This growth appears in sharp contrast with the near lack of grass on adjacent areas of forest or tundra.

SOUTHWESTERN ISLANDS

The most favored locations for straight range livestock production are on Kodiak and adjacent islands and on the Aleutians (fig. 42). Here the climate is tempered by the Japanese Current. The growing seasons are much longer, the winters much milder, and the precipiation higher than on the mainland. It is of interest to note that minimum temperatures are seldom as low as those prevailing in the southern Great Plains of the United States.

Domestic livestock have been grown in limited numbers on these islands ever since they were first brought in by the Russians about 150 years ago. The islands now produce several herds of beef cattle and sheep with little if any winter feed except that provided by grazing a fluctuating band of exposed grassland along the beaches during the winter. Three moderate-sized beef-cattle herds (fig. 43), one large dairy herd, and several head of saddle horses are now maintained on Kodiak Island. A fairly large band of sheep and some beef cattle are grown on both Umnak and Unalaska Islands. Fairly large herds of beef cattle and sheep are located on Sitkalidak Island (fig. 44), and a large cattle herd on Chirokof Island. Other islands suitable for range livestock production include the Trinity, Unimak, and Shumagin groups. A shortage of good harbors and a lack of regular boat service are handicaps to range production on many of these islands.

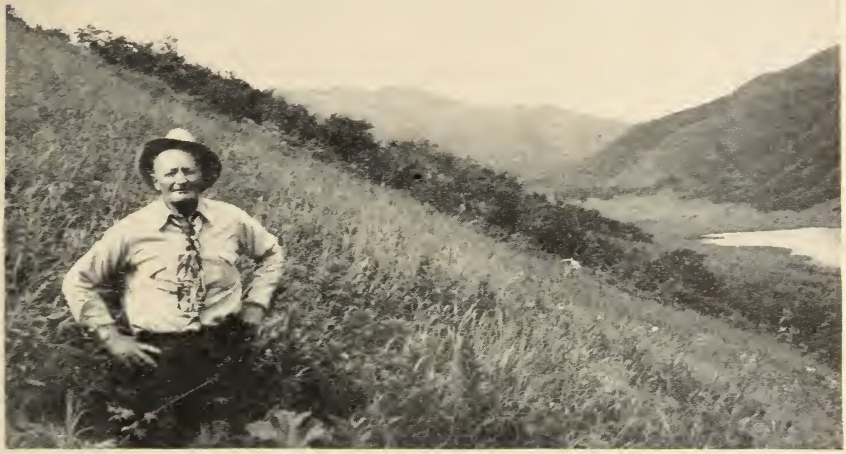

FIGURE 42.—Typically rank growth of native bluetop on sloping hillsides of Jack McCord's Sitkalidak Island cattle and sheep ranch.

A limited quantity of grass hay and silage is produced for wintering beef cows and calves on Kodiak Island, but the remaining range livestock and the herds on the other islands survive on native ranges alone. The development and use of improved forage crops for winter feed would greatly stabilize and expand the livestock industry on these islands. This would also enable the island stockmen to utilize more

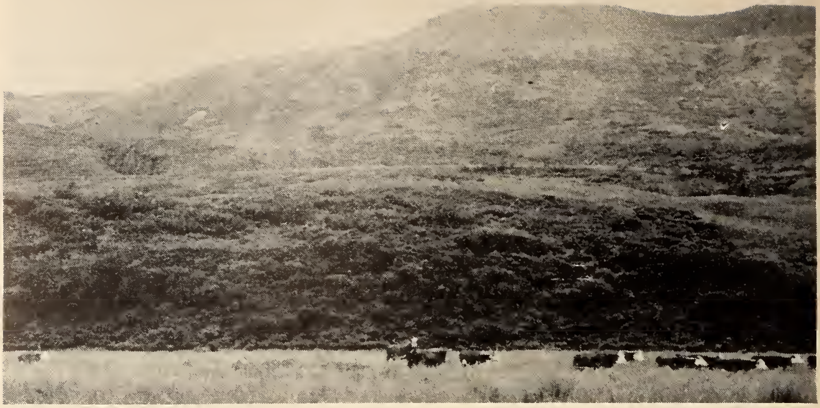

Figure 43.—Hereford cattle on the Felton Ranch in Middle Bay, Kodiak Island.

adequately the vast quantity of range forage available at higher altitudes through the comparatively long growing seasons in these areas.

Hay is extremely difficult if not impossible to cure in the humid climate of these islands. The feed can be preserved either in the form of silage or through the use of special hay-drying equipment to solve the winter feed problem. Most of the native grassland is of a rough hummocky nature, difficult to mow for either hay or silage. This could be corrected by surface tillage, and the vegetation could be improved by overseeding with improved grasses and legumes. Some native range spots on Sitkalidak Island have been greatly improved

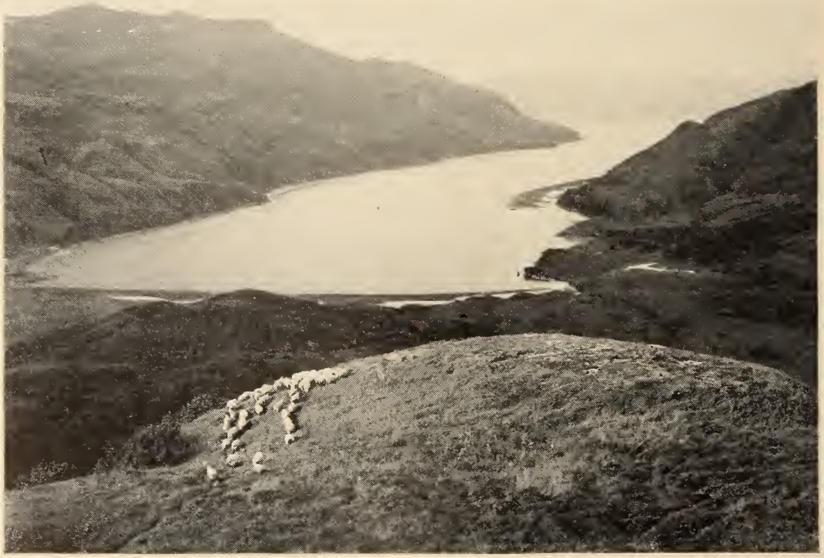

Figure 44.—One of the many scattered flocks of sheep grazing foothill ranges on Sitkalidak Island just above McCord Bay.

by reseeding them to alsike clover and smooth bromegrass. These and other grasses and legumes could be used to advantage in replacing or improving the native ranges on all these islands.

A successful range livestock industry in Alaska could be developed and expanded to best advantage by maintaining breeding herds on the islands. In the more moderate climate, the cows, calves, ewes, and lambs could be wintered well on silage from improved grasses and legumes. The young lambs and yearling cattle could be fattened on summer ranges and improved pastures of the islands or shipped in the spring to be fattened on summer ranges and harvested feeds near the population centers on the mainland.

Although some wool of superior quality is now being shipped from these islands to the States, very few other livestock or agricultural products can be produced economically enough in Alaska to warrant exportation. Therefore, the possibilities for livestock expansion in the Territory are limited largely to the requirements of its own people, to the extent of increase in its steadily growing population, and by the ability of Alaska to solve the many perplexing problems associated with production in the area.

The production of grass-fat livestock on these islands would require the development of refrigeration there and in the boats used to transport the meat. Fortunately, many of the islands have natural waterfalls which could be used to develop power for refrigeration and other purposes.

Fewer stock losses from plant poisoning were reported on these islands than on the Kenai Peninsula or the mainland. Poisonous larkspur is extremely scarce on the islands, although blue monkshood is abundant.

The huge brown bear is a serious if not wholly limiting factor to successful range-livestock production on Kodiak Island. Protection of this animal for the big-game hunters represents a serious barrier to domestic livestock production. Local stockmen favor a program for the eradication of the bear on Kodiak Island. They assert that the bears could be perpetuated for hunting purposes on the Alaska Peninsula, where they are plentiful and climatic conditions are less favorable for any form of agriculture. Beaver, transplanted on Kodiak Island several years ago, have increased greatly and are said to constitute a serious menace to livestock production. Their numerous dams have made sedge marshes of many grass-covered valleys and developed a maze of bogs that have proved to be death traps for cattle. Effective control or eradication of the beaver would lessen these hazards.

KENAI PENINSULA

The second most favorable district for range livestock production includes the Homer area and adjacent section of the Kenai Peninsula. The winter climate there is more severe than on the islands but milder than on the mainland. The semiopen grassland benches can be grazed for 6 or 7 months of the year. A narrow and very limited fringe of beach grasses is grazable for a longer period. Livestock cannot be wintered in this area unless feed is stored for that purpose, since the benchlands remain deeply covered with snow for long periods.

Dairying, mixed livestock farming, and some range cattle and sheep production are carried on in this area (fig. 45). These undertakings could be expanded considerably as a diversified adjunct to crop pro-

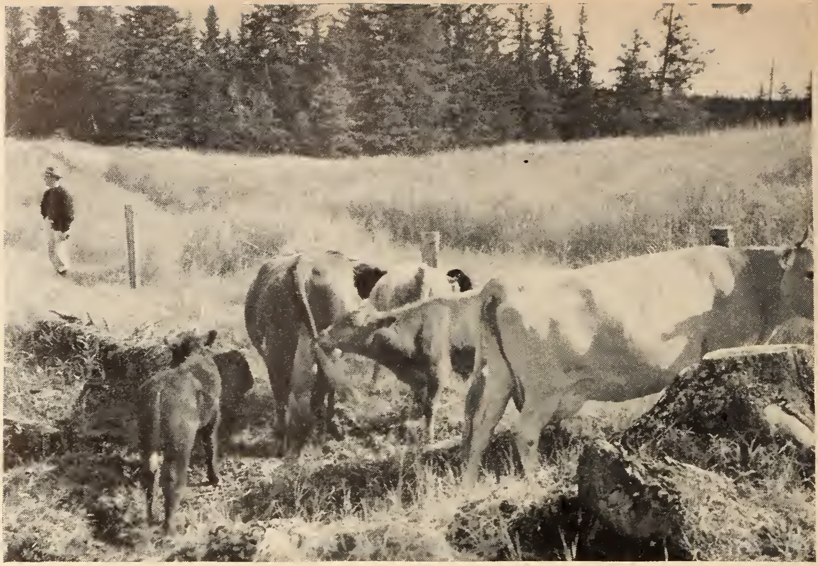

FIGURE 45.—Cattle on closely used stump-lot pasture on the Kenai Peninsula. Note rank development of bluetop across the fence in background.

duction. Agriculture is now handicapped by the isolated nature of the region. This condition will be relieved when a proposed highway is completed from Homer to Anchorage and a suitable harbor and boat dock are constructed in Katchemak Bay.

The development and use of improved grasses and legumes for pasture and silage feeds are essential to the expansion of livestock production in this area. Native and tame hay crops are difficult to cure in the humid climate. Ross (*8*) [1] reported that 10 to 25 days were required to cure hay at the Kenai station in 1905 and 1906. Considerable hay is now cured laboriously in this section through the use of special drying poles and racks (fig. 46). A few trench silos are now being used to preserve range forage for winter feed. An expansion of silage production is indicated as a solution to the winter-feed problem.

The Kenai Peninsula, when connected by a good highway with the population centers along the railroad belt, could be used advantageously as a summer fattening and finishing center for livestock produced on the southwestern islands.

MATANUSKA VALLEY

The Matanuska Valley, the principal farming section of Alaska, has a number of modern dairy farms and produces some sheep, goats, and beef and dual-purpose cattle in connection with the growing of potatoes and other cash crops. The huge requirements for winter feed and the high cost of land clearance in this mainland section are serious limiting factors to stock farming and range livestock production.

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[1] Italic numbers in parenthesis refer to the List of References, p. 124.

Most of the cleared land is now of necessity devoted to cash crops (potatoes and other vegetables) and dairying.

The Territory's requirements for potatoes and possibly dairy products can be met without great expansion of the present production. Overproduction of these products in the future is likely to direct increased attention to the growing of beet cattle, sheep, goats, hogs, and poultry. A steady expansion in the acreage of cleared land is also certain to encourage the production of more forage crops and livestock. Diversification in this direction will also provide manure and require suitable crop rotations for maintenance of fertility and the control of weeds, soil erosion, and plant diseases.

The Matanuska Station and many farmers in the valley are demonstrating the value of well-adapted grasses and legumes for grazing, hay, and silage. Increased production and improved storage of grasses and legumes for winter feed would stabilize the dairy industry in the valley and make it possible to expand greatly the present herds of sheep, goats, and cattle. This would also enable the livestock farmer to utilize more fully the extensive areas of summer range adjacent to or accessible by rail from the valley.

Most of the range livestock could be grazed on these ranges during the summer, fed for a while on valley crops in the fall, and then slaughtered for general distribution in the Territory, only the breeding herd and weaner calves being carried over the winter. Other means of utilizing the summer range are (1) renewing the early-day practice of shipping in steers by steamboat from the States, (2) trucking them in over the Alaska Highway from Canada, or (3) freighting them to the valley from breeding herds maintained on the Kenai Peninsula or southwestern islands.

The principal open or semiopen range areas accessible from the heavily forested Matanuska Valley include Lazy Mountain, Talkeetna, Knik flats, and the watersheds of the Knik, upper Susitna, Little Susitna, Kings, and Chickaloon Rivers and the Willow, Moose,

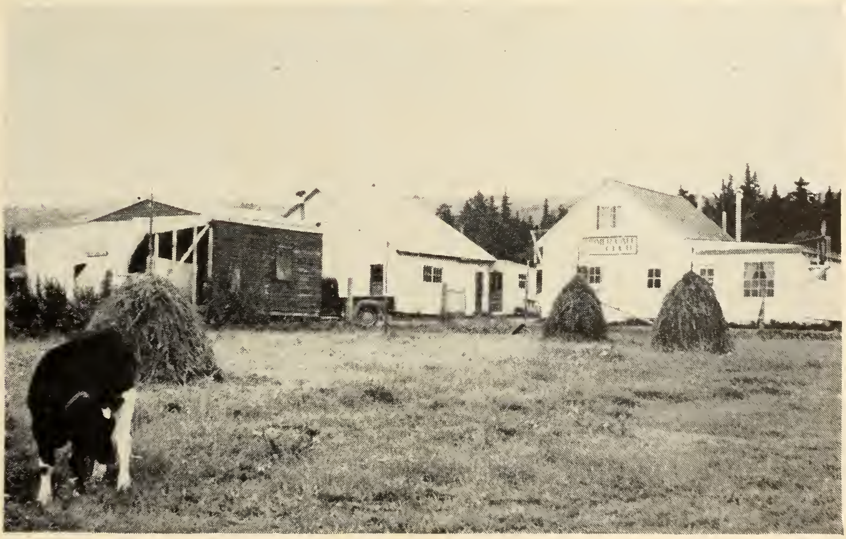

FIGURE 46.—Native hay curing on special drying stakes in the town site of Homer on the Kenai Peninsula.

Wolverine, Granite, and Coal Creeks (fig. 47). The foothill and mountain meadows and slopes, with their rich associations of grasses and weeds, are suitable for grazing both cattle and sheep. Ranges containing dwarf shrubs, open woodland, and tidewater flats are locally considered to be best adapted to use by cattle. Usable only or mainly for wild game are the exteremely high alpine ranges and the lower, swampier sections of some of the valleys.

TANANA VALLEY

Three modern dairy farms, a few flocks of sheep and goats, and some hogs and poultry constitute the present livestock industry of the Tanana Valley (fig. 48). Some settlers are considering the possibility of renewing the early-day practice of growing or at least summering some beef cattle in this section. The winters are longer and more severe in this area than farther south, and the winter feed problems are more acute.

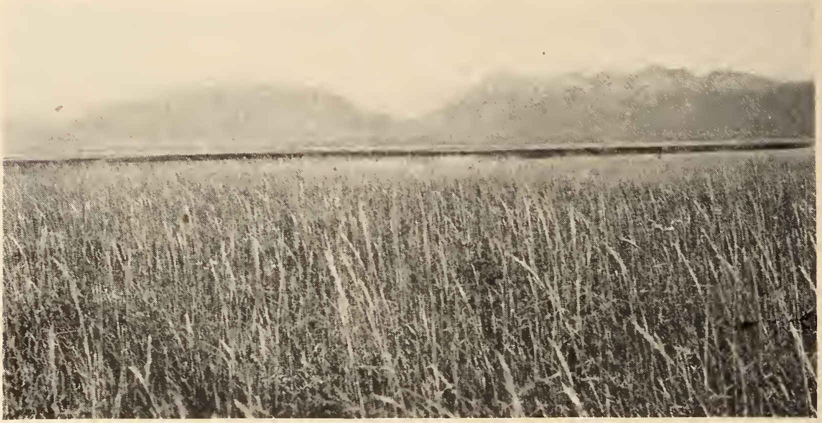

Figure 47.—An extensive expanse of beach wild-rye, lupines, and purple reedgrass provides an excellent source of forage for livestock on the Knik flats of Matanuska Valley.

Smooth bromegrass, Kentucky bluegrass, white clover, alsike clover, red clover, perennial vetch, yellow-flowered alfalfa, and many other forage crops grow well in the valley or on its southern slopes (fig. 49). Increasing the acreage of these crops would be to the advantage of the dairy industry and would facilitate a moderate expansion of other forms of livestock production. Some of the less wooded ranges bordering on the valley were used extensively early in the present century as summer range for cattle and sheep shipped in by boats from the States. This method of production was made unprofitable by the competition of modern refrigerated shipments of meat. The use of these summer ranges for beef cattle and sheep might be renewed if future demands for livestock products justify it.

The grazing season is short in the vicinity of Fairbanks. The average annual rainfall is 11.67 inches; the average winter snowfall, 50 inches. Most of the snow remains unmelted and undisturbed by wind throughout the winter. Consequently, great supplies of winter feed are necessary for the proper maintenance of livestock in this area.

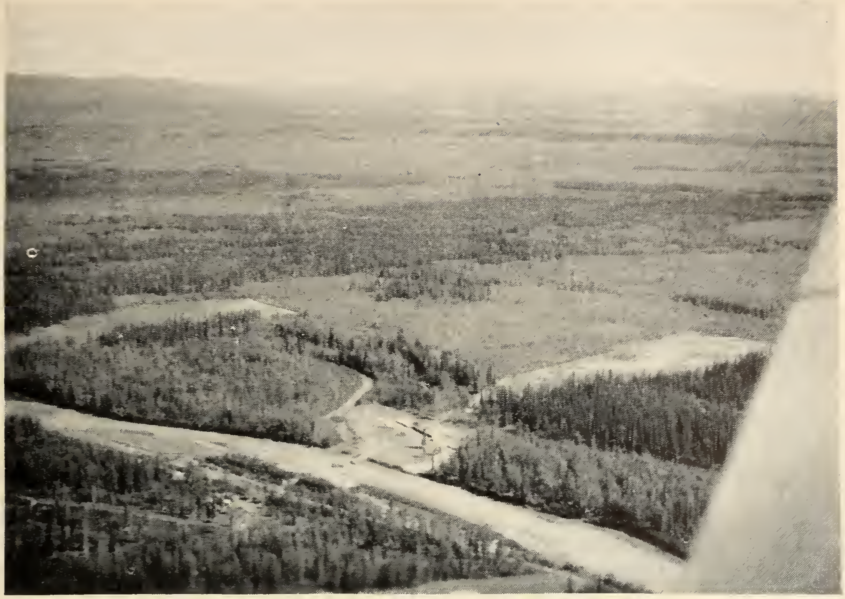

FIGURE 48.—Air view of pioneer homesteads, scrub forests, and marshy bottom lands of the Tanana Valley near Fairbanks.

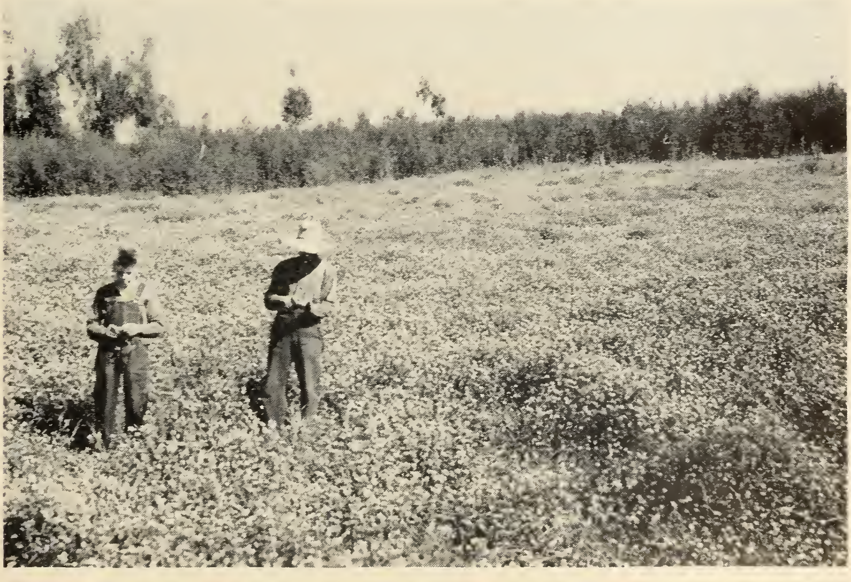

FIGURE 49.—A superb growth of alsike clover on the Fitz farm in the Columbia Creek area, northeast of Fairbanks.

It is of interest to note, however, that small grains usually mature earlier and more completely in the Tanana Valley than farther south. The longer days and warmer, drier summer climate of this inland area are responsible for the advantage in development of cereals.

SOUTHEASTERN PANHANDLE

Only a few small areas of farmable land are present at the base of the high, rugged, and heavily forested region in southeastern Alaska. Some of these areas, consisting mostly of tidal flats, are used for dairy, poultry, and truck farming (fig. 50). No land in this region is suitable for range livestock production and none is available for expansion of other forms of agriculture.

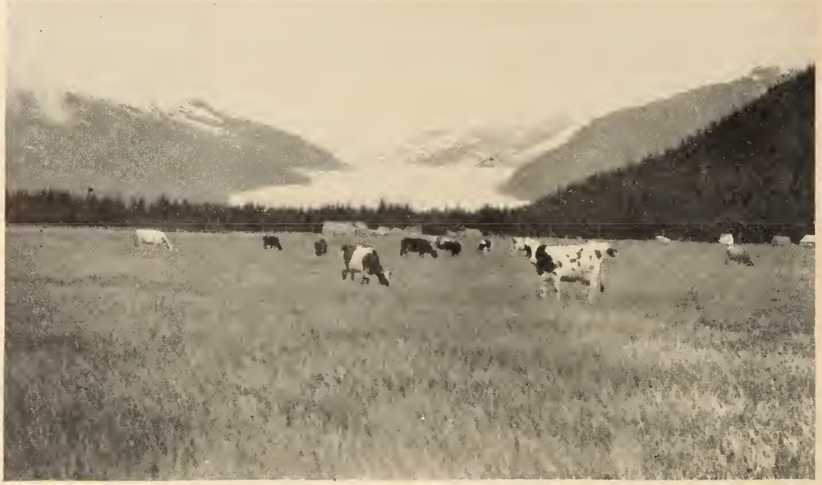

FIGURE 50.—Dairy cattle grazing beach wild-rye and other grasses on the tidal flats below Mendenhall Glacier near Juneau.

OTHER AREAS

If livestock production expands beyond the better farming and stock-raising areas, it will do so in the face of even greater problems and difficulties; but such expansion depends upon greater increase in demand for livestock products than is now indicated.

An extensive area of open range occurs mostly at or above timberline in the Healy-Lignite section west of the Nenana River. This district consists of a series of benches that support a rich growth of bluetop and sedges at the lower elevations and successively more nutritious bunch grasses on the higher sites. This area was used for several years as a year-long range for cattle, sheep, and yak. The livestock were fed some hay and other feeds during the winter, but were reported to have obtained considerable winter grazing from range areas exposed by chinook winds. It is believed that this high range country can be used to best advantage as summer grazing for cattle and sheep shipped in by rail from the Matanuska Valley. This development is not likely to take place, however, until the ranges nearer the valley are fully utilized.

The Big Delta area about 100 miles southeast of Fairbanks was frequently described as a prospective grazing section for beef cattle and sheep. This seems to be a mistake, however, since most of the range appears to be fully utilized by a small herd of buffalo imported from Montana several years ago.

This area is characterized by a shallow soil overlying a plain of cobbly outwash. It supports a short growth of valuable native grasses and legumes. The grass is intermingled with a semiopen scrub forest of shallow-rooted trees, many of which have been burned down or blown over by the high winds that occur in the area. These winds, often of a chinook nature, expose some of the grasses and browse shrubs to winter grazing by buffalo. The limited area of open grassland could probably be expanded by extensive clearing operations, but it seems unlikely that the results would justify the expense. Most of the soils are too shallow for the heavy production of tame grasses and legumes required for winter feed.

An enterprising settler from Montana is establishing a small ranch unit near Circle Hot Springs in the upper Yukon Valley. He harvested considerable quantities of native bluetop and quackgrass hay there and at Circle for the production of dual-purpose cattle. The winters are slightly more severe there than at Fairbanks, but limited livestock production may prove to be successful, if proper provision is made for the development and use of improved grasses and legumes for winter feed.

Much of the land in this valley and on adjacent slopes can be converted into thrifty grassland merely by burning to remove the trees, willows, and moss, according to old-timers in the area. They say, however, that the grassland soon reverts to a moss-covered tundra condition unless the surface growth is removed. An accumulation of old growth is said to shade the ground and raise the permanent ice layer within 18 inches of the surface, which causes the grass to decline in vigor.

Summer ranges are available through many other parts of the interior of Alaska. The Cooper River district, north and east of the river, was at one time a summer cattle range. The industry was discontinued with the abandonment of the railroad in that section. The grazing lands north of the Wrangell Mountains, around the headwaters of the Tanana River, would provide grazing for at least part of the year for sheep and cattle. The Goodpaster country north of Big Delta also has large areas of land that could produce winter feed and summer grazing.

As the country is settled and the demand for livestock products increases, these and other areas of Alaska, including the Kuskokwim, Yukon, and lower Tanana Valleys, may be developed for grazing purposes. This is not indicated as a possibility for many years, although a few goats are now produced in the lower Kuskokwim Valley.

TUNDRA RANGE

The vast tundra area of northern, western, and other parts of Alaska may be utilized to best advantage for the production of reindeer, caribou, musk oxen, and possibly yak (fig. 51). This extensive and largely undeveloped domain is deserving of reconsideration for these purposes.

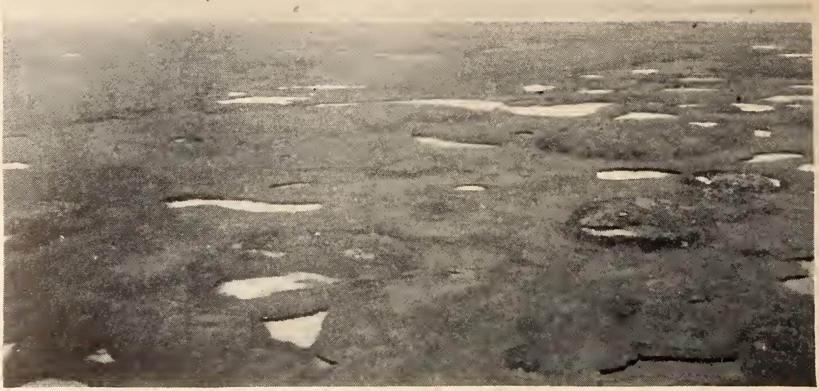

Figure 51.—The flat, marshy, lake-covered terrain in the Kuskokwim Valley is typical of much of Alaska.

Decimation of the once vast herds of reindeer in Alaska is said to be the direct result of wolf depredations and lack of care. Many Alaskans favor an intensive program of wolf eradication as a prerequisite to successful reindeer production.

The musk ox, once a hardy native of Alaska, was rendered extinct by early explorers. Thirty-four young musk oxen were brought from Greenland to Alaska in 1930. They were maintained, domesticated to some extent, and increased at the Bureau of Biological Survey Station near Fairbanks for several years. Finally, in 1935 and 1936, the entire herd was shipped to Nunivak Island, where in 1946 they were being maintained on a range heavily overgrazed by reindeer. It is believed that efforts should be made to return these hardy animals and test them for use on the vast tundra ranges of the mainland.

Yak were imported from Tibet via Canada in 1919, 1923, and 1930. They were said to have been used successfully in crosses with Galloway cattle at Fairbanks and with both cattle and buffalo in Canada. After being carried on the ranges at Fairbanks and in the Healy-Lignite area for a few years, the hybrids were slaughtered and the purebreds turned loose on the Big Delta range, where they failed to survive the first winter, an unusually severe one. Informal reports indicated that the yak received for these tests were from one of the smaller and less hardy strains of Tibet. It is reported that yak are used for transport, food, and clothing by natives in the high frigid climate of Tibet and northern Mongolia, where they are said to subsist during the winters on the grasses, tundra, and browse of wind-swept slopes. It is believed that hardy strains of yak should be imported for further tests and possible use on the tundra ranges of Alaska.

RANGE AND PASTURE PROBLEMS

Efficient use of the ranges and tame pastures of Alaska depends upon the development and preservation of adequate winter feed supplies. This is the principal problem confronting the livestock producer. It can be solved best through the use of trench silos, but much needs to be learned about the combination of forage crops that gives the highest yield and most nutritive silage. Hay-drying equipment is worthy of investigation, but drying hay is likely to be more costly than making silage.

Hay is difficult to cure in the humid climate of the Territory. Native grasses are seldom cut early enough for best results as hay or silage. They are said to be lacking in nutritive qualities when mature, and become weakened in vigor when cut or grazed annually.

The rough hummocky nature of most of the natural grasslands makes them difficult to mow for hay or silage. The old growth left on native grasslands hinders mowing, delays thawing, retards new growth, and reduces the feeding value of the harvested forage. Surface tillage offers possibilities for leveling hummocky grasslands and for adding tame grasses and legumes to the native mixture. Very little is known, however, about how to proceed with this type of development.

Burning constitutes a practical means of removing old growth, lowering the frost level, and encouraging new growth, but if done at the wrong time it is likely to result in a ground fire that may destroy most of the humus in the soil. Careful studies are necessary to determine under what conditions burning may be helpful. Piper (*7*) reports that burning in March encourages the growth of native grasses, but that burning in June is likely to destroy the grass as well as the moss and result in heavy infestations of fireweed (*Epilobium angustifolium*).

Many tame grasses and legumes are well adapted to Alaskan conditions and offer possibilities for producing nutritious forage greatly superior to the native plants. Very little is known, however, about how best to establish, manage, and maintain these plants in thrifty production. This information can be obtained only through a sound research program in which the more promising species are tested in pure and mixed stands under different grazing and fertilizer treatments. Very little factual information is available as to the proper mixture of grasses and legumes to use for hay, pasture, and silage on various soil types. Intensive investigations are necessary to determine the nutritive qualities of these forage crops and the kind and amount of supplements required to correct deficiencies.

Developing improved strains of the better forage plants by intensive plant breeding has received scarcely any attention to date. The possibilities to be derived from this line of investigation are unlimited. The highly variable and promising Siberian alfalfa should respond rapidly to a breeding program for the development of superior forage and seed-producing strains.

Seed supplies of adapted strains of many forage crops are seriously lacking and need rapid development. Different sources of seed of a given variety often give highly variable responses to Alaskan conditions.

Many Alaskan soils are shallow, raw, and lacking in fertility. Application of commercial fertilizers and barnyard manure are required to maintain crop production soon after the land is cleared. Much more needs to be known about the kind and quantity of fertilizer required under different soil conditions. Weed-infested manures have aggravated the weed problem in many instances. Nitrate liberation is often seriously retarded by the slow decomposition of manure during the short summers and at the low soil temperatures prevailing in the Territory.

Wind erosion is a serious problem on many soil types in the Matanuska Valley and to a lesser extent elsewhere in Alaska. Water erosion is of less importance, but both types are intensified in many cases by the continuous production of vegetables and the failure generally to use crop rotation systems including grasses and legumes.

Practically no reliable information is available to indicate how best to graze and manage the native ranges and reseeded pastures of Alaska. The susceptibility of many plant species to injury through continuous grazing or mowing indicates the importance of using these plants on a rotation basis. Investigations are necessary to determine the degree and frequency of use required to obtain maximum production without injury to the vegetation.

Hardy varieties of wheat, oats, and barley thrive and usually mature on the mainland. They are often used with vetch or peas for bundle feed, hay, or silage. However, growing these annual crops for forage purposes often costs much more than producing perennial grasses and legumes. Furthermore, the perennials usually complete their growth during the drier parts of the season when they can be harvested more readily. The grain-pea-vetch mixtures are much more difficult to harvest during the rainy fall season. Also the grain crops often become badly infested with weeds, because these crops have to be planted so early weeds cannot be properly controlled in advance.

Willows and other brush often invade cleared land that has been seeded to permanent pasture. Some form of brush control similar to those developed in the States is necessary to combat this problem. Selective chemicals, such as 2, 4–D, may be used to great advantage in controlling weeds and other troublesome plants.

Short drought periods occur frequently during the early summer in the Tanana Valley and to a lesser degree in the Matanuska Valley and on the Kenai Peninsula. A perennial plant to be wholly successful in Alaska must be capable of rapid growth and possess combined resistance to drought, wind and water erosion, severe cold, soil heaving, and competition from other plants.

The permanent ice layer that underlies most of the interior lands of Alaska constitutes a special problem. The melting ice often provides running water for livestock and power development and moisture for farm crops, but it frequently causes the surface soil to subside unevenly and thus necessitates additional expense for releveling the land.

Mosquitoes, moose flies, and "no-see-um" gnats constitute a serious menace to livestock production, especially during the early summer. These pests are much less troublesome on extensive wind-swept areas of cleared land or on naturally open grasslands than they are near trees and shrubs. Some of these pests may respond to special spray treatments such as are used for fly control in the western United States.

Poison plants cause infrequent death losses among livestock in Alaska, but such losses may increase as the livestock industry expands.

Predatory animals, as stated earlier, are a serious problem to the livestock producer in several sections of Alaska. Programs are recommended for the eradication of bear, wolves, and other pests wherever they constitute a menace to domestic livestock.

Other problems which beset the stockmen and farmers of Alaska include the scarcity of good roads; a faulty tax system on land that encourages absentee ownship at the expense of land and community development; lack of truly effective cooperative marketing organizations among farmers; a shortage of storage facilities for meat and other farm products; poor harbors on the Kenai Peninsula and on many of the southwestern islands; insufficient long-term credit for extensive land clearance; poor grading of farm products; and the continued reluctance of some Alaska merchants to use locally produced farm commodities.

ESTABLISHMENT AND MAINTENANCE OF GRASSES AND LEGUMES

Best stands of the small-seeded grasses and legumes are obtained when the soil is treated with a corrugated "cultipacker" before seeding. The soil should be well plowed if trashy, and disked if cloddy. If the soil is clean, it may be disked lightly. The spike-tooth harrow should be used freely until the soil is well pulverized. After the seed has been broadcast on the surface, cultipack again, going crosswise of the direction of the first cultipacking. This firms the soil and usually covers the seed sufficiently for good germination, and it also brings the soil moisture to the surface so that the seed will germinate readily. Harrowing in the seed usually covers the small seed so deeply that many of the plants cannot reach the surface.

Large seed, such as that of bromegrass, may be mixed with the grain in the drill box and drilled in. Grains best adapted for this purpose are wheat or barley. Grasses and legumes have been broadcast on land seeded to oats and peas for hay or silage with good results. When this is done, the grass and legume seed is broadcast on the surface after the grain has been drilled in. The soil should then be cultipacked. Binding the hay crop is advisable so that the grain stubble will hold the winter snow and protect the grass and legume plants.

Grasses and legumes should be seeded as early in the spring as the soil can be worked. If the seed cannot be sown at that time it may be seeded at the beginning of the rainy season in early July. In the Matanuska and Tanana Valleys, grasses and legumes may be seeded at any time so that the young plants are well established before winter comes. Where the snow blows off, leaving the soil exposed, it is best not to clip or pasture too late in the fall, and not at all the first season.

The seed may be broadcast by hand, by a cyclone seeder, or by using the grass-seeding attachment on the grain drill. Usually the large seeds will flow unevenly, if at all, through the grass seeders. Large grass seed may be broadcast quite evenly by using a broadcast fertilizer spreader. This method will be found satisfactory for mixtures of the larger seeded grasses, but where the mixture contains a percentage of very small seed, such as that of redtop, the various-sized seeds in the mixture will not flow out uniformly.

Grasses and legume meadows used for pasture usually become packed and require renovating. This can be done by disking or by using a spring-tooth harrow. Where the maximum yield of hay or pasture is expected, some form of nitrate fertilizer must be applied. Soils in the central and northern districts of Alaska, covered by forest, contain only a small amount of decayed humus and the soil nitrate is quickly exhausted by cropping.

Agricultural practices with various field crops in the Tanana Valley region necessitate the application of a considerable amount of commercial fertilizer or the use of green manure crops as a source of organic matter and nitrogen. As yet no standard commercial fertilizer formula has been established for each type of crop. In order, therefore, to find the relative value and efficiency of each of the main fertilizer elements—nitrogen, phosphorus, and potassium—a soil-fertility test with barley was made in the field. The results clearly indicate that nitrogen and phosphorus are the most effective elements used in the fertilizers.

Applications of a nitrate fertilizer at the rate of 200 pounds per acre to the grass plots on the Alaska Experiment Station at Palmer more than doubled the yield of dry hay. Legumes responded most readily to phosphate fertilizers. Nitrate fertilizers applied to legumes induced abnormal growth, and as a result there was not sufficient food storage in the roots of the plants. A high percentage of winterkilling has followed heavy applications of nitrate fertilizers on legumes. Fertilizers to be of maximum value should be applied at the beginning of the growing season.

It has been found that broadcasting 150 to 400 pounds of a commercial nitrate fertilizer or spreading 6 to 8 tons of barnyard manure per acre on grass meadows in the spring at the beginning of the growing season will more than double the yield of hay or pasture. One hundred pounds of nitrate fertilizer broadcast on the surface of the soil when legumes or grasses are seeded will induce quick growth and a better stand will result.

A plot treated with ammonium sulfate produced grass and alfalfa that was dark green in color, thick, and leafy. The yield of green forage, calculated on the per acre basis, was 15,306 pounds. The per acre yield of dry hay was 6,349 pounds. A plot treated with treble superphosphate produced a yield of green forage of 9,872 pounds per acre and 4,528 pounds of dry hay.

These yields are of economic importance to the livestock industry, which is increasing rapidly in Alaska. For example, at present the standard hay in the Matanuska area is composed of oats and peas or oats and vetch. These crops are annuals and quite expensive to produce, since the soil must be prepared and seeded each year. In 1943, at the Matanuska Station, the average yield of oat-pea hay, fertilized with ammonium sulfate at the rate of 100 pounds per acre, was 2.7 tons per acre. In comparison, the yield of alfalfa-grass mixture, where ammonium sulfate was applied, averaged 3.05 tons per acre. The average yield of green material (oats and peas) for silage at this station during 1943 was 12,340 pounds per acre, as compared with 15,306 pounds per acre of the grass-legume mixture fertilized with nitrate.

Grasses and legumes when used for pasture are the cheapest source of feed for farm animals. Rotational grazing, which permits the pasture to recover after beng grazed and avoids the danger of overgrazing, has shown its advantages over continuous grazing. Pastures are at their best when the grass is about 3 to 4 inches high and is growing rapidly. Rotating the pastures permits a supply of succulent, high-protein feed to be used cheaply with maximum results at minimum cost.

For hay, the grasses are at their best if cut when the heads have emerged from the sheath or boot and are just coming into flower. In the central and northern sections of Alaska the first crop may be cut and left in the swath for a day or two until it is partially cured. It may then be raked and shocked, or, if a side-delivery rake is used for windrowing, a hay loader will pick up the dry hay for loading at minimum expense. Where grass and legume mixtures are used for hay, care must be taken that the stems of the legumes are well cured. If too much moisture remains in the stems, there is danger of heating in the stack or mow.

Preliminary trials were run at the experiment station to develop a technique for mow curing of mixed hay, primarily oats and peas, which will produce a high-quality hay under the unfavorably humid conditions commonly encountered during the harvest season of these crops in Alaska. The usual practice of curing on the ground or on racks in the field has not been satisfactory. Usually these methods result in high cost and a low quality of hay.

In 1945, a system of tunnels was built in the hay mow, a 3-foot propeller-type fan installed, and 15,041 pounds of oat-pea hay placed on the mow-curing system. The first cutting of hay, 9,153 pounds on a 20-percent-moisture basis, was partially cured in the field and contained 59 percent moisture when placed in the mow October 3. This cutting made a layer about 3 feet deep on the tunnel system and cured satisfactorily. A second cutting of hay, cut October 5 and mowed October 10, contained 70 percent of moisture when placed in the mow. It did not cure well in the center of the mow where the hay was compact, but cured fairly well at the edge of the mow where it was loose. Due to the fact that equipment arrived late in the season, the curing of the hay was of necessity delayed beyond the normal time of hay making in the valley. This handicapped the curing process considerably. Humidity ran high, and temperatures were so low that evaporation of moisture from the hay in the mow actually froze the hay if the fan was kept in constant operation. It was evident from this one year's work that mow curing of hay is entirely feasible under Matanuska conditions if several precautions are observed:

1. Hay making must be completed during September to avoid extremely low temperatures which greatly retard evaporation and may cause the hay to freeze in the mow before being cured.
2. Hay must be well wilted in the field before being placed in the mow.
3. Some means must be employed to keep the hay from becoming too compact in the center of the mow.
4. A shallow layer of hay, probably not over 3 feet deep, must be placed on the dryer and cured thoroughly before any more hay is placed in the mow.

ALASKAN GRASSES

The following incomplete list of Alaskan grasses include those encountered during the exploratory studies; those examined in herbariums maintained by the University of Alaska, the Commission of Agriculture for Alaska, and the University of Washington; and those reported by other investigators as occurring in Alaska or having been introduced and tested there. It is hoped that this partial list and discussion will serve to encourage the development of a more complete list with specific information as to local occurrence, adaptation, soil requirements, forage value, and other practical considerations. The grasses are discussed alphabetically by genera and in general order of importance by species.

WHEATGRASSES (*AGROPYRON*)

This hardy genus of cool-weather grasses is represented in Alaska by 13 perennial species, which are highly variable in growth characters. The group includes three introductions from Siberia. Five of the species spread by vigorous rhizomes or rootstocks. The remainder are bunch types. All the importations and a few of the natives have been tested on a limited scale at experiment stations in the Territory. The preliminary results are indicative but not conclusive. Further and more extensive trials are necessary to determine the adaptation and relative value of these and other grasses under the highly variable soil and climatic conditions of Alaska.

A few of the more important wheatgrasses of Alaska include quackgrass, slender wheatgrass, and bearded wheatgrass. Quackgrass (*Agropyron repens*), an introduced species, is of general occurrence in the Territory. It has been used successfully in producing excellent hay and pasture in the vicinity of Circle, Fairbanks, and Palmer, where it is fully winter hardy (fig. 52). Spreading rapidly by rootstocks, it has, however, become a pest difficult to eradicate from several cultivated fields in the Tanana and Matanuska Valleys.

Slender wheatgrass (*Agropyron trachycaulum*) is a hardy native bunchgrass of frequent occurrence in Alaska. It is regarded as one of the most promising hay and pasture grasses tested at the Matanuska

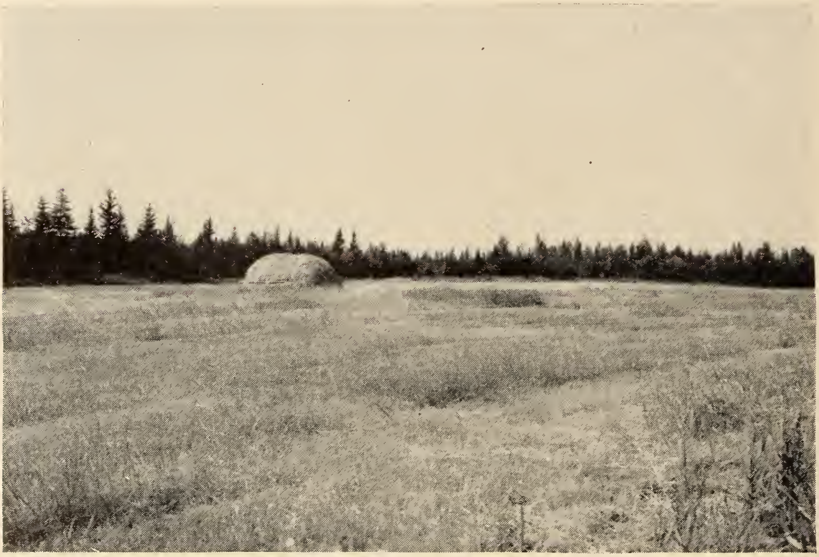

FIGURE 52.—Quackgrass hay meadow along the upper Yukon near the Arctic Circle.

Station, but at Fairbanks it is shorter lived and less valuable. Though the foliage is highly nutritious and palatable, stock graze it best at the early stages of growth. When mature the leaves become rather rough and less palatable. This wheatgrass provides only a medium amount of forage as compared with bromegrass or meadow fescue. It has a definite place in any hay mixture of grasses because of its bunching character and the consequent space between plants.

Bearded wheatgrass (*Agropyron subsecundum*) is a tufted native of rather wide occurrence in central Alaska and on Kodiak and Sitkalidak Islands.

Western wheatgrass (*Agropyron smithii*) was reported as being fully winter hardy at the Fairbanks Station, but it produced little hay. This rhizomatous spreading native of Canada and the Great Plains occurs sparingly in central Alaska, where it is believed to have been introduced with hay shipped in for livestock. It appears to be worthy of further and more extensive trial.

Crested wheatgrass (*Agropyron cristatum*), a native bunchgrass of Siberia, is highly regarded for its cold hardiness and grazing value in the Northern States and Canada, but it has given poor results in the few tests conducted in Alaska. Irwin (*4*) described the Fairway strain as being an undesirable grass at Fairbanks, stating that it decreased from a good stand in 1938 to a scattered stand in 1940 and made a minimum of growth. Dr. Bensin reported informally that this strain of crested wheatgrass survived with poor growth on upland at Fairbanks but winterkilled on lowland. Irwin stated that 1939 and 1941 seedings of both the Fairway and Standard strains were hardy at the Matanuska Station but the forage was sparse and the grasses of little value as hay or pasture. No stands of crested wheatgrass were in evidence at this Station in 1946.

Native wheatgrasses of little-known value in Alaska include bluebunch wheatgrass (*Agropyron spicatum*), of minor occurrence in the central sections. Alaska wheatgrass (*Agropyron alaskanum*) is a bunch type of the Matanuska Valley, the Arctic coast, and the upper Yukon Valley. Yukon wheatgrass (*Agropyron yukonense*) occurs in the central and upper Yukon Valley. It spreads by rootstocks. Alpine wheatgrass (*Agropyron latiglume* or *Agropyron violaceum*) is of general occurrence in Alaska. Wheatgrass (*Agropyron sericeum*) is a tufted perennial occurring at Nome, Matanuska, and on the upper Yukon, according to Anderson (*1*).

Intermediate wheatgrass (*Agropyron intermedium*), tall wheatgrass (*Agropyron elongatum*), and thickspike wheatgrass (*Agropyron dasystachyum*) suffered severe winter injury in test plantings made at the Matanuska Station in 1940.

BENTGRASS *(AGROSTIS)*

The true redtop should not be confused with the native bluetop. Redtop (*Agrostis alba*) is a perennial hay grass of considerable value in the coast district of Alaska. Further north it has been badly weakened or killed entirely under adverse winter conditions. This grass does best on soils where moisture is abundant. Spreading by means of rhizomes, it forms a tough, compact sod which resists grazing and trampling by livestock. On soils that are inclined to be dry it makes only medium to poor growth. Under favorable conditions it produces a high yield of leafy hay that is relished by livestock. Tested briefly at six locations in Alaska, redtop was not considered dependable at Rampart, appeared to be poorly adapted at Sitka, and winterkilled completely after 4 years at Copper Center, but it was regarded as well adapted at Kodiak and on the Kenai Peninsula. Some evidence of winterkilling was observed at Matanuska, especially during dry winters when the ground was bare of snow.

Creeping bent (*Agrostis palustris* or *A. maritima*) occurs sparingly along the southern coast. It gave good results in seeding tests at the old Kodiak Station but died the first winter in three seedings made at the Matanuska Station. Similar results were reported for the seaside strain of this grass at Matanuska.

Other bentgrasses and the sections in which they are found in Alaska are as follows: Northern bentgrass (*Agrostis aequivalvis*), southwestern and southeastern sections; Alaska redtop (*A. alaskana* or *A. melaleuca*), coastal districts, the Aleutians, and southeast; Arctic redtop (*A. borealis*), Aleutians and from the coast of Bering Sea eastward; spike redtop (*A. exarata*), a variable bunchgrass of common occurrence on moist soils in the Aleutians and southeast; Idaho redtop (*A. idahoensis*), coastal districts from the Aleutians, southeast; Ross redtop (*A. rossae*), Kodiak; ticklegrass (*A. scabra* or *A. hiemalis*), subalpine areas, central and south; meadow redtop (*A. stolonifera*), native of central sections; colonial bent (*A. tenuis*), southeast (most of the plants died in a single test planting at Matanuska); and Thurber's redtop (*A. thurberiana*), moist areas of the Aleutians and central sections.

FOXTAIL *(ALOPECURUS)*

Meadow foxtail (*Alopecurus pratensis*) appears to be fully winter hardy and well adapted to Alaskan conditions (fig. 53). It produced heavy yields of very leafy growth on lowland and upland at Fairbanks and did fairly well in early tests at Sitka. It offers possibilities for use in mixtures with other grasses and legumes on moist soils. Short-awned foxtails (*A. aequalis*) appeared to be the most common native foxtail in Alaska. It is found on wet soils throughout most of the Territory. Other native foxtails of Alaska include alpine

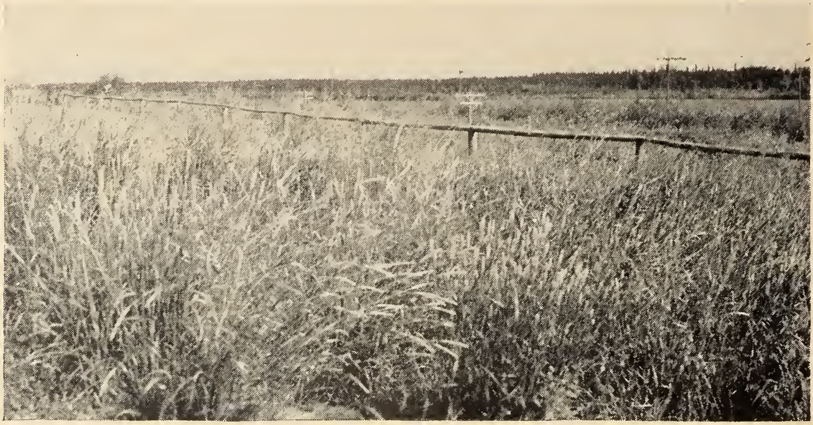

FIGURE 53.—Leafy growth of meadow foxtail on the Fairbanks Station grounds.

foxtail (*A. alpinus*), along the Arctic coast and in central sections; marsh foxtail (*A. geniculatus*), in extremely wet situations in the southeast; and glaucus foxtail (*A. glaucus*), on a coastal region of Bering Sea.

BLUESTEM *(ANDROPOGON)*

None of the bluestem grasses occur naturally in Alaska. Little bluestem (*Andropogon scoparius*) and big bluestem (*A. furcatus*) were introduced from the States and tested at the Matanuska Station, where they winterkilled the first year.

VERNALGRASS *(ANTHOXANTHUM)*

Sweet vernalgrass (*Anthoxanthum odoratum*), a native of Eurasia, has been established at Unalaska and elsewhere in the Territory. It is regarded as having no forage value, but it gives fragrance to hay when used in mixtures with other grasses.

OATGRASS *(ARRHENATHERUM)*

Tall oatgrass (*Arrhenatherum elatius*), is a perennial well-adapted to moist soils where snow cover protects the roots during the winter. It grows rapidly in tufts or bunches, beginning growth early in the spring, and produces an excellent crop of leafy hay or fair pasture. The hay is palatable, nutritious, and does best in mixtures with such grasses as smooth bromegrass, timothy, meadow foxtail, and slender wheatgrass. Trials of this grass at stations along the southern coast of Alaska produced exceptionally heavy hay yields, the plants often reaching a height of 4 to 6 feet. It was regarded as promising for both pasture and hay in early tests at Sitka and on the Kenai Peninsula, but winterkilled after 1 to 4 years in the interior.

OATGRASS *(AVENA)*

Wild oat (*Avena fatua*) occurs as an annual weed in southeastern Alaska.

SLOUGHGRASS *(BECKMANNIA)*

American sloughgrass (*Beckmannia syzigachne*) is of general occurrence in wet places in the Territory.

GRAMA *(BOUTELOUA)*

Blue grama (*Bouteloua gracilis*) died the first winter in seedings made at the Matanuska Station in 1937.

BROMEGRASS *(BROMUS)*

Smooth bromegrass (*Bromus inermis*) appears to be one of the most promising grasses tested by experiment stations and grown by farmers in Alaska (fig. 54). It is a long-lived perennial adapted to practically all agricultural areas of Alaska. Because it grows rapidly and spreads by underground rhizomes, as well as by seed, it quickly forms a sod that binds the soil. It is a good pasture or hay grass, stands trampling and grazing, is palatable, begins growth early in the spring and provides pasture throughout the entire summer, is

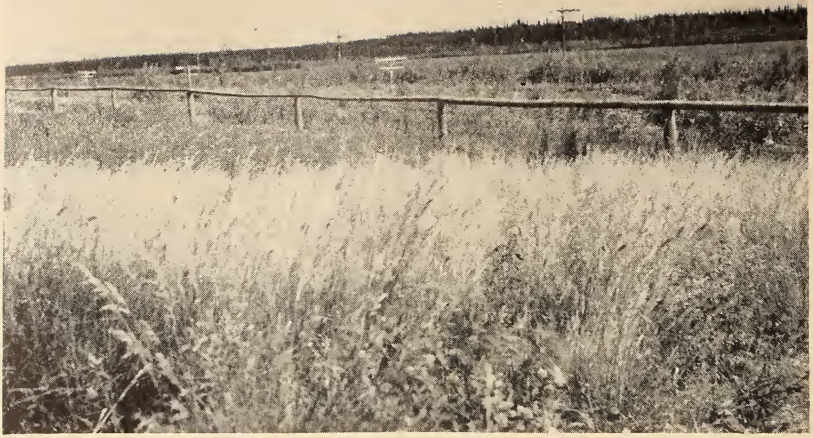

Figure 54.—Fully headed growth of smooth bromegrass near Fairbanks.

fully winter hardy, and resists drought. The stems grow upright, varying in height from a few inches to 3 feet, depending on the amount of plant food and moisture present in the soil. Early-cut, well-cured hay of this grass was rated equal to imported alfalfa hay by dairymen at Fairbanks. The grass offers possibilities of being established readily in native vegetation of Alaska by reseeding after the hummocky terrain has been surface tilled and at least partly leveled. It is also used to excellent advantage in mixtures with alsike clover in various parts of Alaska (fig. 55). This grass appears to be superior in nutritive qualities to native bluetop, especially in the cured stages of growth. It is one of the most promising grasses, either alone

Figure 55.—An excellent pasture mixture of smooth bromegrass and alsike clover near Fairbanks.

or in mixtures with other grasses and legumes, for silage for winter feed.

Meadow bromegrass (*Bromus erectus*), a native perennial bunchgrass of Europe, has shown promise for growth and winter hardiness in limited trials at the Matanuska Station.

Mountain brome (*Bromus marginatus*) and variations of the species occur at various locations in Alaska, perhaps as introductions from the States. Particularly vigorous specimens of this grass were collected on Unalaska Island. A strain introduced from the Northwestern States winterkilled in tests at Fairbanks and Matanuska.

Native perennial bromegrasses of Alaska include Aleutian bromegrass (*Bromus aleutensis*) of the Aleutians and southeast, fringed bromegrass (*B. ciliatus* or *B. richardsoni*) of the central sections, Pacific bromegrass (*B. pacificus*) of the southeast coastal area, Arctic bromegrass (*B. pumpellianus*) at Nome and elsewhere in the Bering Sea region, and Alaska bromegrass (*B. sitchensis*) along the southeast coast.

Weedy-type annual bromes of the Territory include rattlesnakechess (*Bromus brizaeformis*), hairychess (*B. commutatus*), soft chess (*B. mollis*), small-flowered chess (*B. racemosus*), cheat (*B. secalinus*), and downy chess (*B. tectorum*).

BUFFALO GRASS *(BUCHLOË)*

Buffalo grass (*Buchloë dactyloides*) was introduced from the Great Plains and seeded at the Matanuska Station in 1937, where it was reported by Irwin as producing a scattering stand and dying the first winter.

REEDGRASSES *(CALAMAGROSTIS)*

The native reedgrasses of Alaska include eight species, according to Anderson (*1*), and five according to Hitchcock (*3*). Both authorities report several subspecies of this highly variable genus.

Bluetop (*Calamagrostis canadensis*) is by far the most abundant and most widely distributed native grass in Alaska. This tall, fine-stemmed, leafy grass is often mistakenly referred to as "redtop" by residents of the Territory. Special efforts should be made to limit the use of this name to the true redtop (*Agrostis alba*).

Bluetop occurs in nearly all sections of Alaska from above the Arctic Circle southward. It is often barely perceptible on the tundra or in forested areas, but thickens rapidly and grows vigorously on these sites when the original cover is disturbed or removed (fig. 56). The grass is particularly vigorous and abundant on the Kenai Peninsula and southwestern islands (fig. 57). It flourishes with nearly equal vigor along the railroads and highways and on burned-over areas in the interior.

The grass appears to be finer in quality than most native tall grasses of the States. It grows rapidly and heads out early in the summer, by late June or early July, and many of the leaves and stems remain green until frost. It is utilized to advantage as pasture, hay, or silage. The hay is of good quality when cut early and cured well, but most Alaskan hay is cut too late in the season for best results. It is believed that maximum food materials are retained in the grass when it is cut before July.

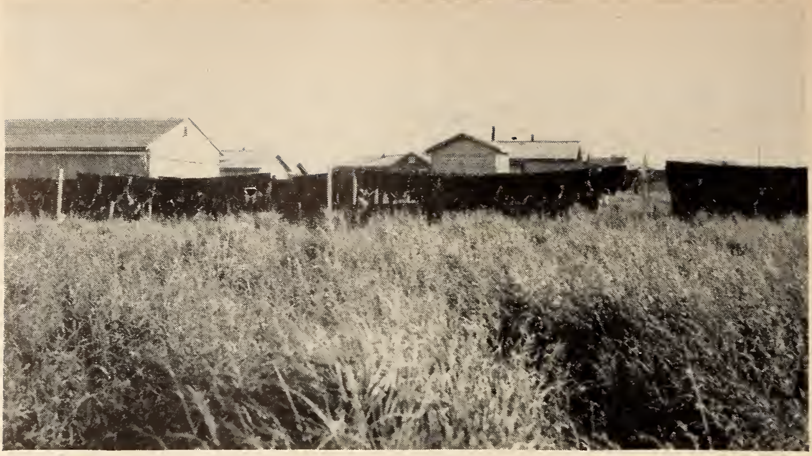

Figure 56.—Bluetop thrives nearly everywhere in Alaska. Here it is growing well on ungrazed but disturbed portions of Nunivak Island in Bering Sea. This growth contrasts sharply with the severely overgrazed conditions of adjacent reindeer and musk oxen range. Note reindeer hides hung to dry.

Most residents of Alaska regard bluetop as lacking in nutritive qualities, particularly in the advanced or cured stages of growth. Our chemical analyses indicated, however, that the feeding value of this grass would compare favorably with that of many of the native tall grasses of the States. All such grasses usually decrease rapidly in food value as they approach maturity and are seldom regarded highly as cured feed unless harvested early. Some samples of bluetop and

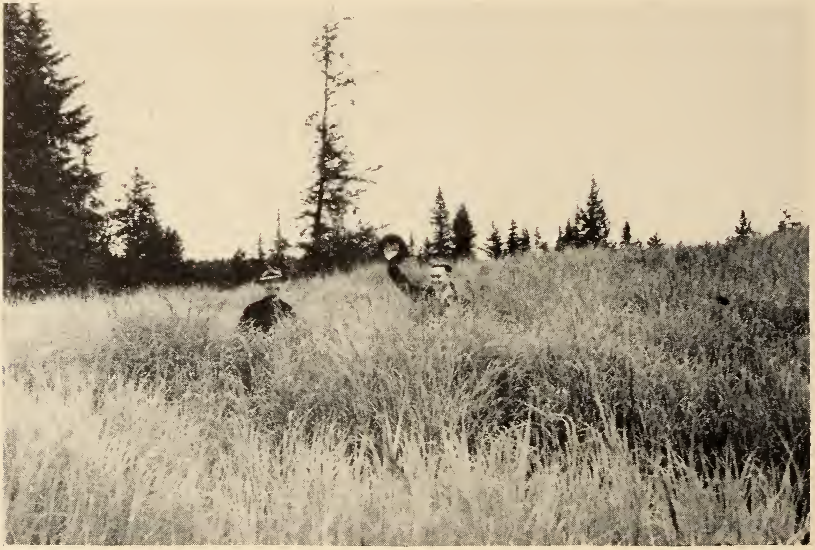

Figure 57.—Rank growth of native bluetop on semiopen range land of the Kenai Peninsula near Homer.

other Alaskan grasses showed border-line values for phosphorus and a surprising shortage of calcium.

Local experience and observation indicate that bluetop plants are rapidly reduced in vigor by successive annual mowings or continuous grazing. Rotational use of the grass is indicated as a desirable practice. The inability of bluetop and other native grasses of Alaska to withstand close and frequent use is undoubtedly the result of the conditions under which they have evolved. These plants, unlike those of the Great Plains, have had no opportunity to develop resistance through generations of use by buffalo or domestic livestock.

Many tame grasses appear to be superior to bluetop in nutritive qualities and grazing resistance. The abundance of bluetop, however, justifies extensive tests to determine definitely its relative feeding value and how best to manage and utilize it.

Purple reedgrass (*Calamagrostis purpurascens*) is one of the common reedgrasses at comparative low elevations. Others are: Reedgrass (*C. deschampsioides*), west coast; Holm reedgrass (*C. holmii*), St. Paul Island; northern reedgrass (*C. inexpansa*), generally on wet sites; Lapland reedgrass (*C. lapponica* or *C. alaskana*) and narrow reedgrass (*C. neglecta*), Bering Sea region; and Pacific reedgrass (*C. nutkaensis*), coast and Aleutians.

WOODREED *(CINNA)*

Drooping woodreed (*Cinna latifolia*) is a tall perennial native of the Alaska Range and Pacific Coast sections of Alaska.

COLPODIUM

Anderson (*1*) reports two species of this genus: *Colpodium fulvum* in shallow water or mud throughout most of the Territory, and *C. wrightii* on the Seward Peninsula.

DACTYLIS

Orchard grass (*Dactylis glomerata*), an introduced perennial native of Europe, showed lack of promise in early tests conducted at six locations in Alaska. It died the first winter in one seeding at Fairbanks and in three seedings at Matanuska, and was reported as seldom lasting longer than 4 years at other locations. However, the grass was observed growing vigorously and heading well on the Zentner Ranch on Kodiak Island.

OATGRASS *(DANTHONIA)*

Poverty oatgrass (*Danthonia spicata*) occurs on rocky soils in southeastern Alaska.

HAIRGRASS *(DESCHAMPSIA)*

Tufted hairgrass (*Deschampsia caespitosa*) is of common occurrence on rocky soils in woodlands and mountain meadows and on seashores. The numerous fine basal leaves of this small bunchgrass rate high in grazing value. Other highly variable hairgrasses include mountain hairgrass (*D. atropurpurea*), a loosely tufted grass in the Bering Sea region; Bering hairgrass (*D. beringensis* or *D. bottnica*), said to hybridize with tufted hairgrass on the Aleutian and Pribilof Islands;

annual hairgrass (*D. danthonioides* or *D. Calcyina*); slender hairgrass (*D. elongata*); wavy or crinkled hairgrass (*D. flexuosa*), a densely tufted grass encountered at Attu and Sitka; and California hairgrass (*D. holciformis*), along the coast near Ketchikan.

DUPONTIA

Dupontia fischeri is a low-growing plant of the Arctic and Bering Sea coasts.

WILD-RYE *(ELYMUS)*

Beach wild-rye (*Elymus mollis*) often mistakenly referred to as beach ryegrass, is one of the more important native tall grasses of Alaska. It usually occupies a narrow belt of sandy soil just above the high-tide level in most coastal districts (fig. 58). It is an important sand binder, and valuable for hay, pasture, and silage. It is also used by Eskimos for weaving baskets and thatching dwellings.

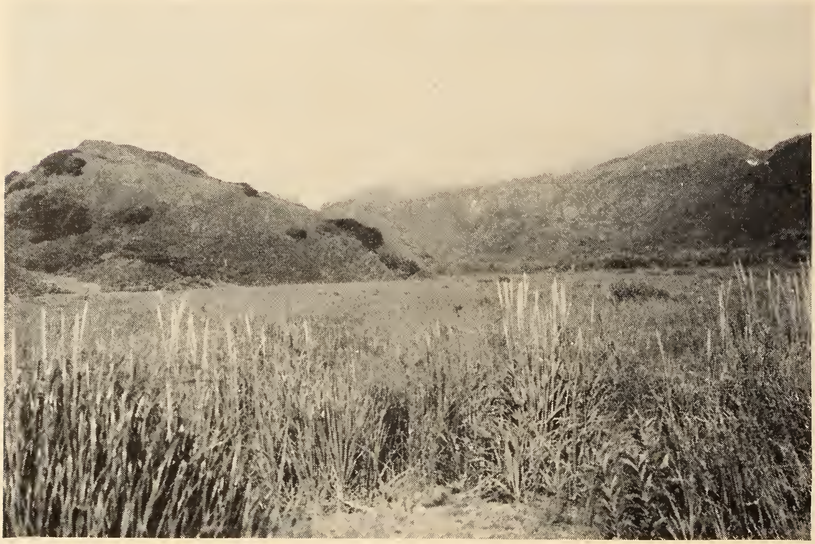

Figure 58.—Beach wild-rye in foreground and bluetop in background and on distant hills, Tom Felton Ranch, Kodiak Island.

The thick stems and leaves of beach wild-rye are difficult to cure as hay in the humid climate of the Territory. Grazed in the cured stages of growth, this grass often constitutes the sole winter feed of beef cattle, sheep, and horses on Kodiak, adjacent islands, and the Aleutians, and along Katchemak Bay on the Kenai Peninsula. Nutritive qualities of the grass are said to be superior to those of bluetop in the cured stage. Beach wild-rye is reported, however, to be equally susceptible to frequent use. It apparently becomes weakened rapidly by continuous grazing or successive annual mowings. Rotational use is indicated as a desirable practice in the proper management of this grass.

Downy wild-rye (*E. innovatus*) is a medium-tall grass of light forage value that occurs in nearly all of the potential livestock-producing regions of Alaska. Colonies of this slightly rhizomatous perennial were encountered on many grassy flats, foothills, and low mountain meadows. It was grazed readily by cattle and sheep on Sitkalidak Island.

Russian wild-rye (*Elymus junceus*) is one of the newly introduced pasture grasses that has proved exceptionally well adapted to the Matanuska Valley. To date, it has not been tried extensively elsewhere in the Territory. Its habit of growth is bunching, the naked seed stalks rising from the center of the plant. It produces an abundance of leaves resembling those of cultivated winter rye. Its deep-rooting habit enables it to grow through the entire summer, but it produces a very light seed crop. The yields of this grass have been higher than those of other grasses tried. It is palatable and nutritious, but the foliage has a high moisture content. The plants begin growth early in the spring and recover quickly from clipping or grazing. It is well adapted for seeding in mixtures for pasture. Russian wild-rye was regarded by Irwin (*4*) as being one of the best grasses tested at the Matanuska Station. It appeared to have some promise on upland at Fairbanks but winterkilled on lowland.

Canada wild-rye (*Elymus canadensis*) was encountered frequently along the Alaska Railroad where it occurred either as a native or an introduction from the States. Some seed sources of this grass failed to survive the winters at Matanuska, while others were fully winter hardy and were regarded as promising leafy hay types. Siberian wild-rye (*Elymus sibiricus*) proved to be fully winter hardy at Matanuska, but made scanty early growth and was rated poor in forage value when mature. Blue wild-rye (*Elymus glaucus*) is a native bunchgrass of southeastern Alaska. A strain of this grass, apparently from the Northwestern States, winterkilled the first year in a seeding made at Matanuska.

Other wild-ryes of the Territory include Aleutian wild-rye (*Elymus aleuticus*), a rhizomatous species on Atka Island: Pacific wild-rye (*Elymus virescens* or *Elymus howellii*), a bunchgrass of the southeastern sections; northern wild-rye (*Elymus hirsutus or Elymus boreale*) of the coastal districts; and Macoun wild-rye (*Elymus macounii*) of the central areas.

FESCUE *(FESTUCA)*

Several native and tame fescues are well adapted to Alaskan conditions and are especially promising in providing green, palatable, and nuritious growth late in the season when many other grasses are coarse and stemmy. The more valuable fescues include creeping red fescue, meadow fescue, and Siberian fescue.

Red fescue (*Festuca rubra*) is one of the hardiest of the pasture grasses. It spreads by underground rootstocks from the joints of which new plants arise. Its aggressive characteristic makes it valuable as a soil binder. The leaves are slender, usually grow upright, and are much relished by all classes of livestock. Under favorable conditions, red fescue makes a heavy stand of forage, beginning growth early in the spring. It recovers quickly from clipping or grazing and grows throughout the entire summer season, furnishing a continuous source of pasture. It is adapted to a wide range of soil types, is winter hardy, and lives for many years. This grass withstands pest injury in the fall and remains palatable and nutritious until grazed or covered with snow. All the fescues are hardy under icing conditions. Creeping red fecue is considered an excellent grass to use in mixtures with smooth broomegrass and Kentucky bluegrass. It withstands competition with bluegrass better than does meadow fescue.

Meadow fescue (*Festuca elatior*) begins growth fairly early, but after the second to third year the stand becomes scattered. By the fifth year all the plants are winterkilled. It makes good pasture and hay but must be reseeded frequently. The new strains Alta and Kentucky No. 31 may give a different performance.

Siberian fescue (*Festuca altaica*), a native bunchgrass of wide distribution, is rated highly for grazing purposes. It is prominent on rocky soils in the Healy-Lignite and Big Delta grazing areas and occurs from Seward Peninsula to the upper Yukon, Aleutian Islands, and southeastern Alaska (*5*).

Various forms of red fescue are common in the Territory. Alpine fescue (*Festuca ovina* var. *brachyphylla*) a dense bunchgrass, was collected near Dutch Harbor. Hard fescue (*Festuca* var. *duriuscula*) was collected near Cold Bay. Bearded fescue (*Festuca subulata*) occurs on shady banks and in moist thickets in the southeast. Sheep fescue (*Festuca ovina*) and Chewings fescue (*Festuca rubra* var. *commutata*) are rated among the better grasses adapted to the Tanana and Yukon Valleys.

MANNAGRASS *(GLYCERIA* OR *PANICULARIA)*

Six species of mannagrass are represented in Alaska. All are perennials and considered palatable to livestock, but they are limited in distribution and confined mainly to aquatic, marshy situations. The group includes northern mannagrass (*Glyceria borealis*), downy mannagrass (*Glyceria leptostachya*). American mannagrass (*Glyceria grandis*), weak mannagrass (*Glyceria pauciflora*), fowl managrass (*Glyceria striata*), and mannagrass (*Glyceria pulchella*).

HOLYGRASS, OR SWEETGRASS *(HIEROCHLOË, SAVASTANA,* OR *TORRESIA)*

This group of erect, sweet-smelling perennial grasses is rather common in meadows, moist places, and rocky slopes, and includes alpine holygrass (*Hierochloë alpina*), Arctic holygrass (*Hierochloë pauciflora*), *and sweetgrass* (*Hierochloë ororata*).

VELVETGRASS *(HOLCUS)*

Velvetgrass (*Holcus lanatus*) is a European grass that is reported to have been introduced and naturalized in southeastern Alaska.

BARLEY GRASS *(HORDEUM)*

Foxtail barley or squirreltail barley (*Hordeum jubatum*) is a weedy-type perennial grass of common occurrence in fields, meadows, and waste places throughout most of the Territory. Meadow barley (*H. nodosum*) was collected in the Aleutians. J. W. Thompson of Washington University referred to this species by the synonymous names of *H. boreale* and *H. brachyantherum*. The presence of these troublesome grasses in bluetop ranges is considered an indicator of overgrazing.

RYEGRASS *(LOLIUM)*

Ryegrass is the name often mistakenly applied in Alaska to the wildrye grasses of the *Elymus* species. The true ryegrasses, perennial or English ryegrass (*Lolium perenne*), and Italian ryegrass (*L. multiflorum*), proved to be extremely short-lived and of little value in early tests in the Territory. The annual darnel grass (*L. temulentum*) was reported by Anderson (*1*) as having been collected near St. Michael.

MELICGRASS *(MELICA)*

Alaska oniongrass (*Melica subulata*) is a medium-tall perennial grass of rare occurrence in the Territory. It was collected on Unalaska Island.

CANARY GRASS *(PHALARIS)*

Reed canary grass (*Pharlaris arundinacea*) proved to be unable to withstand more than one to three winters in early tests. It may be worthy of further trial in areas favored by the Japanese Current. It was producing vigorous growth at Fairbanks in 1946.

PHIPPSIA

Phippsia grass (*Phippsia algida*) is a low annual of the Arctic region.

TIMOTHY *(PHLEUM)*

Alpine timothy (*Phleum alpinum*) is an important constituent of the native ranges in many parts of Alaska, particularly in mountain meadows. It occurs in conspicuous association with bluegrass and bluetop on the sheep ranges of Sitkalidak Island.

Timothy (*Phleum pratense*) is a perennial grass that is adapted to moist or fairly damp soils. It grows in fairly compact tufts, is leafy, and has a high dry-matter content. For this reason it is best adapted for use as hay. Trials in most sections of Alaska show that it is not well-adapted to the soil and climatic conditions, except in the coastal districts and central interior. For 1 or 2 years it makes a fairly heavy growth, but after the second year the crops are light. It starts growth late in the spring and recovers slowly from grazing or cutting. Leaf growth of timothy is less heavy than that of bromegrass, tall oatgrass, or meadow fescue. Mixed with other grasses, it seems unable to compete and dies out in a few years. Mixed with alsike clover on low, moist soils it produces a heavy crop of excellent hay the first 2 years. Its sod-forming habit causes it to become root-bound after the second year. Where this occurs, renovation with a disk or spring-tooth harrow will help materially in increasing the yield of hay.

BLUEGRASS *(POA)*

Kentucky bluegrass (*Poa pratensis*) is one of the most valuable fully hardy, tame pasture grasses of Alaska. It is exceedingly aggressive under favorable moisture conditions, spreads rapidly to form a dense soil-binding turf, and should be used sparingly in a pasture mixture because of its tendency to crowd out other species. White clover and creeping red fescue persist well in competition with Kentucky bluegrass. Smooth bromegrass, if grazed moderately to maintain it in the stand, may be used to advantage in mixtures with Kentucky bluegrass.

Of all the varieties of alfalfas tried at the several stations, only the yellow-flowered Siberian alfalfa (*Medicago falcata*) (fig. 59) has been found hardy under all conditions. Its shallow, fibrous root system enables it to withstand soil heaving. Stands of this alfalfa established at the Rampart Station near the Arctic Circle in 1909 were still doing well in 1946 after 37 years under winter temperatures of 40° to 70° below zero. Crosses of Grimm and other hardy varieties with this species, though giving promise for a time, have not proved consistently hardy, and practically all of them have winterkilled. These crosses were tried at Rampart, Fairbanks, and Matanuska with the same results. Grimm, Cossack, Ladak, and Canadian variegated alfalfas, in most instances, lived for several years at the three stations named, but the stands diminished and eventually died out. The yellow-flowered Siberian alfalfa has three weaknesses: It starts slowly in the spring, makes rather short growth, and the hay yields are comparatively light.

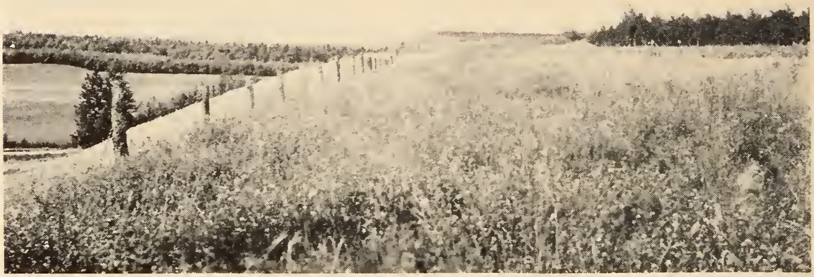

FIGURE 59.—An excellent stand of yellow-flowered Siberian alfalfa on upland at the Matanuska Experiment Station.

There are numerous common Siberian-hybrid plants in the fields of Siberian alfalfa. These natural hybrids are promising material for selection of adapted improved types. Arrangements were made in 1948 to increase this important legume in Utah for general use in the Territory.

Many native bluegrasses occur as important constituents of the native range, especially at higher elevations where bluetop is not so aggressive. They are highly regarded for palatability and nutritive qualities, particularly on foothill ranges of the southwestern islands.

The combined reports of Hitchcock (*3*), Anderson (*1*), and Walker (*10*) list a total of 31 native and introduced bluegrasses for Alaska. These are: Low speargrass (*Poa abbreviata*), alpine bluegrass (*P. alpina*), big bluegrass (*P. ampla*), annual bluegrass (*P. annua*), Arctic bluegrass (*P. arctica, cenesia*, or *williamsii*), *Poa brachyanthera*, Canada bluegrass (*P. compressa*), dune bluegrass (*P. confinis*), large-flowered speargrass (*P. eminens*, *glumaris*, or *trinii*), Eyerdam bluegrass (*P. eyerdamii*), glaucus bluegrass (*P. glauca*), *Poa gracillima*, hispid bluegrass (*P. hispidula*), *Poa irrigata*, Komarov bluegrass (*P. komarovii*), lanate bluegrass (*P. lanata*), loose-flowered bluegrass (*P. laxiflora*), bog bluegrass (*P. leptocoma*), large-flumed bluegrass (*P. macrocalyx*), Merrill bluegrass (*P. merrilliana* or *glacialis*), wood bluegrass (*P. nemoralis*), Norberg bluegrass (*P. norbergii*), fowl bluegrass (*P. palustris*, *triflora*, or *crocata*), *Poa paucispicula*, Kentucky bluegrass (*P. pratensis*), timberline bluegrass (*P. rupicola*), *Poa rotundata*, Sandberg bluegrass (*P. secunda*), narrow-flowered bluegrass (*P. stenantha* or *acutiglumis*), rough bluegrass or rough-stalked meadow grass (*P. trivialis*), and Turner bluegrass (*P. turneri*).

BEARDGRASS *(POLYPOGON)*

Rabbitfoot grass or annual beardgrass (*Polypogon monspeliensis*) occurs sparingly as a weed in the Territory.

ALKALI-GRASS *(PUCCINELLIA)*

Haupt's alkali-grass (*Puccinellia hauptiana*) is an important grass on the tidal flats of the Matanuska Valley and on similar sites elsewhere. It occurs just below the belt of beach wild-rye and purple reedgrass, immediately below the high-tide level.

Anderson (*1*) lists the following additional species with their locality of occurrence as indicated: Alaska alkali-grass (*Puccinellia alaskana*), Pacific coast areas; Anderson alkali-grass (*P. andersoni*), Arctic coast; northern alkali-grass (*P. borealis*), along coast and rivers; smooth alkali-grass (*P. glabra*), tidal flats of southwest coast and islands; large alkali-grass (*P. grandis*), salt marshes of southwest; Hulten alkali-grass (*P. hulteni*), beaches of Kodiak Island and southeast; Pacific alkali-grass (*P. nutkaensis*), along the coast and Aleutian Islands; Arctic alkali-grass (*P. paupercula*), Aleutians and east through Arctic; creeping alkali-grass (*P. phryganodes*), brackish swamps along coast; small alkali-grass (*P. pumila*), along coast and on Kodiak Island; and three-flowered grass (*P. triflora*), shores of Cook Inlet.

SCHIZACHNE

False melic (*Schizachne purpurascens*) is a tall erect perennial in wooded areas.

WEDGEGRASS *(SPHENOPHOLIS)*

Slender wedgegrass (*Sphenopholis intermedia*), an erect perennial, occurs sparingly in the Tanana Valley.

TRISETUM

Spike trisetum or downy oatgrass (*Trisetum spicatum*) is one of the more widely distributed short bunchgrasses of Alaska. It resembles the sand lovegrass (*Eragrostis trichodes*) of the Plains, and is regarded as being highly palatable and nutritious. Nodding trisetum (*T. cernuum*), and Siberian trisetum (*T. sibiricum*) are of less common occurrence.

LEGUMES

In Alaska, the seasons are short and the precipitation rather heavy during the blooming and seeding period of legumes. The seed crop of the legumes except white clover are comparatively light. Seed either does not mature or matures so late that it is often damaged by early frosts. Apparently only a legume with spreading, fibrous root system will consistently withstand soil and climatic conditions in Alaska.

Few of the clovers and alfalfas have been found satisfactory in extensive trials at the several stations. Seed of the varieties that have proved hardy either is not available or is difficult to obtain. White clover (*Trifolium repens*) does well in most instances, although it is likely to winterkill when seeded alone where snow blows off. The Russian red clover (*T. pratense*) usually does well and makes good yields of hay, but it, too, winterkills where exposed to severe winter conditions without snow covering. Occasionally the white Dutch clovers have winterkilled, but it has been found that the small-leaved plants of this variety are less susceptible to injury by winter conditions than the larger leaved type. Alsike clover (*T. hybridium*) is the best generally adapted legume at present. It grows in most of the hay meadows and favorable waste areas and at roadsides. Sweetclovers seldom live over the first winter. Perennial vetches (*Vicia cracca* and *V. tenuifolia*) have been found hardy in most instances, especially when seeded in grass mixtures. They set seed readily and also spread by underground stems. The annual vetches and Canadian field peas do exceptionally well and make a heavy crop of forage. They are usually sown with oats in a mixture for hay or silage.

In a few favorable locations, purple-flowered alfalfa plants have lived for a number of years. Usually, however, varieties of the *Medicago sativa* type, which have purple blossoms, have lived from 1 to 3 years and then succumbed to winter conditions. This is due to several causes, among which are a straight tap root with few side branches; late growth induced by heavy rains during or near the fall freezing period, which does not permit sufficient food deposits in the roots to carry the plant over the winter; saturation of the soil, permitting insufficient oxygen to penetrate to the roots; ice sheets due to melting snows and rains during the winter months; heaving of the soil due to periodic thaws and freezes with no snow cover; and the shape of the plant crown, which ordinarily stands above the surface of the soil. Whatever the cause, no permanent plantings of purple-blossomed alfalfa have been successful in Alaska.

Many native legumes occur in Alaska. Most of them are said to be palatable to livestock. The palatable forms have apparently not been eradicated by heavy grazing as they have been in many of the Western States. It would be wise for Alaskans to try to perpetuate these valuable species by increasing, testing, and using them under cultivation. Many of them would undoubtedly be valuable in pasture and silage mixtures.

Native lupines are particularly abundant. They include Arctic lupine (*Lupinus arcticus*), *L. nootkatensis*, and *L. rivularis*.

Joint-pod or licorice root (*Hedysarum americanum* and *H. boreale*) are eaten readily by buffalo in the Big Delta section of the Tanana Valley.

Beach pea (*Lathyrus maritimus*), *peavine* (*L. palustris*), meridian beach pea (*L. japonicus*), and *L. polustris* var. *pilosus* are eaten avidly by all classes of livestock.

The native vetches include American vetch (*Vicia americana*), an uncommon plant of the interior; *V. palustris*, a good forage plant of wide distribution; and *V. sitchensis*, a large vetch of the coastal areas.

Nine species of the loco genera occur in Alaska, but none of them is considered poisonous or toxic to livestock. Neither of the two principal poisonous locos of the States occurs in the Territory. The native milkvetch group includes alpine milkvetch (*Astragalus alpinus*), a small purple-flowered species occurring in every section of Alaska; American milkvetch (*A. americanus*), a large-leaved, vigorous, white-flowered species of the interior; *A. falcata*, a distinctive small-leaved species of gravelly plains; *A. umbellata*, an interior alpine species; and *A. littoralis*.

The oxytrope group of loco-like plants includes *Oxytropis campestris* of the entire coast and interior, *O. deflexa* of the interior, and *O. maydelliana* of alpine sites. *O. glabrata* was not encountered in the Territory but is reported by Rydberg (*9*) as occurring there. Other loco-like plants not collected but reported for Alaska by Hadwen and Palmer (*2*) include *O. mertensiana*, *O. nigrescens*, *O. podocarpa*, and *O. sewardensis*.

OTHER RANGE FORAGE PLANTS

The ranges of Alaska abound with countless forbs, sedges, rushes, and browse shrubs, many of which are valuable for grazing purposes. Much forage of this type is particularly suited to use by sheep and goats. Musk oxen, reindeer, yak, and caribou can also make good use of many of these classes of forage. Reindeer and caribou show a marked preference for lichens except during the summer, when they eat the tender shoots of grasses, sedges, and many other plants, according to Palmer (*6*).

OTHER FEED CROPS

Mixtures of oats with peas or vetch are commonly grown as hay crops or bundle feed for livestock. They are, however, more costly to produce than perennial grasses and legumes and mature later in the season when the weather is less favorable for harvest. Nearly all the hardier varieties of oats, wheat, and barley produce mature grain in many parts of the Alaska mainland and could be grown as concentrated supplements to other livestock feeds. The development of fish-oil meal as an important side line to the fishing industry would also provide a valuable source of protein for livestock feed.

POISONOUS PLANTS

Larkspur (*Delphinium* sp.), waterhemlock (*Cicuta* sp.), and monkshood (*Aconitum* sp.) are the more common poisonous plants of Alaska (fig. 60). One or the other of these species is undoubtedly responsible for the occasionally reported loss of livestock in the Matanuska Valley and on the Kanai Peninsula. The roots of waterhemlock and monkshood contain a deadly poison that is said to have been extracted by the natives to use on darts and spears. The tops of these two plants are eaten readily by livestock with no apparent ill effects. The roots, when forced to the surface by frost, constitute a menace to livestock. Cow-parsnip (*Heracleum lanatum*), locally known as pootschky, is similar to waterhemlock in general habit of growth, but is not considered poisonous. It is eaten avidly by Eskimos and Aleuts.

Other poisonous plants of occasional occurrence are meadow rue (*Thalictrum kemense* and *T. alpinum*) and death camas (*Zygadenus elegans*).

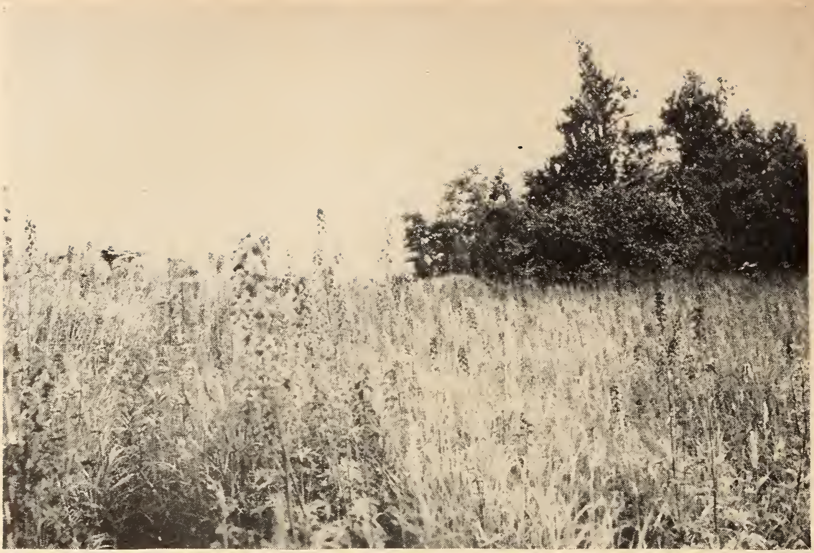

Figure 60.—Poisonous larkspur and waterhemlock infesting a bluetop meadow near Palmer.

Scouring rush (*Equisetum* sp.) occurs as an important constituent of many native hay crops. It is grazed by livestock and eaten readily in the form of hay with no apparent ill effects.

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Report on Exploratory Investigations of Agricultural Problems of Alaska

Chapter 4. Horticulture in Alaska

By Roy Magruder, *principal horticulturist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering*

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In Alaska, as in every pioneer country or community, horticulture is of primary importance because it furnishes the fresh vegetables and fruits essential to the health of the settlers. In addition, horticulture provides flowers and other ornamental plants, which are valuable in maintaining morale in a frontier territory. Staple nonperishable commodities must always be provided from other areas, so the success of gardens and the availability of edible wild plants and fruits usually determine the outcome of the homesteaders' efforts in the early years of the settlement of any new area.

EXTENT OF THE INVESTIGATION

Studies of horticultural production and problems in Alaska were made by the task group during July and August 1946. Although this investigation covered only a small part of the year, several hundred gardeners supplied information that gave a good cross section of the problems encountered throughout the growing season as well as those of storage and preservation during the winter months.

Travel by airplane and motor car made it possible for the horticulturist of the group to see gardens and talk with gardeners along the Steece Highway between Fairbanks and Circle City, stopping at Miller's House, Central, and Circle Hot Springs en route; along the Richardson Highway between Fairbanks and Glenallen; Glenn Highway between Glenallen and Anchorage; along the Willow road between Palmer and Willow; in the Tanana Valley in the vicinity of Fairbanks; in the Matanuska Valley in the vicinity of Palmer; at Wasilla and Knik, in the vicinity of Homer on the Kenai Peninsula;

near the town of Kodiak and the naval base on Kodiak Island; and in the towns of Valdez, Cordova, Juneau, Sitka, Petersburg, Wrangell, and Ketchikan and their environs.

Other members of the party were able to observe gardening along the Tanana River between Nenana and Tanana; along the Yukon between Tanana and Circle; along the Alaska Highway between Buffalo Creek and Northway; from the junction of the Glenn and Richardson Highways to Chitina; along the Elliott Highway to Livengood; on the islands of Nunivak, Chirikof, and Sitkalidak; along the railroad between Fairbanks and Anchorage; and in the towns of Nome, Bethel, Bettles, and Seward.

Explorations were also made of the horticultural possibilities of the lands of the military installations on the Aleutian Islands at Dutch Harbor, Cold Bay, Umnak, Amchitka, Adak, and Shemya.

GENERAL HORTICULTURAL PROBLEMS

A number of problems that affect all branches of agriculture in Alaska have been pointed out in Chapter 1 and other chapters. They will be reviewed again here with emphasis on the ways in which they affect horticulture. Concerted action by the Federal, Territorial, and municipal governments and by local groups of citizens will be necessary to solve some of these problems efficiently and speedily.

Soil selection—The first problem that confronts the prospective horticulturist is the selection of his land. To make an intelligent selection he should have available information on the soil type or classification, depth or thickness of the various layers, natural cover or vegetation, its agricultural usefulness, distance to permafrost (if any), distance to water table, direction and degree of slope, and if possible the chemical composition of the general soil type.

Climatological data.—More climatological data on the principal agricultural regions are needed. The present weather stations do not adequately cover the potentially valuable agricultural areas.

Transportation facilities.—Since most horticultural products are perishable, rapid and reliable transportation is essential to commercial horticultural enterprise. This means access to roads that are passable through most of the year, to consuming markets, shipping points, or storage and utilization centers. Improved water, rail and air transportation is important for bringing in the necessary machinery and crop-production supplies (fig. 61). Completion of the proposed highway from Homer to connect with that to Anchorage will greatly stimulate agricultural and horticultural activity on the Kenai Peninsula.

Land clearing.—Land clearing is the most expensive and hardest problem of the new settler in Alaska. Not only is he interested in the cheapest and quickest method of clearing and fitting the land for its first crop, but he should also be interested in the method which best preserves the organic matter in the soil.

Organic matter.—Maintenance and increase of organic matter is especially important in the production of horticultural crops on the sandy loam soils of the Tanana and Matanuska Valleys and on the Kenai Peninsula. Crop rotations, green-manure crops, cover crops, and efficient use of animal manures, composts, and peat or muck as

FIGURE 61.—Loading vegetables into plane for shipment from Homer to Kodiak, Alaska.

supplements need to be studied in relation to the maintenance of organic matter in the soil and effects on crop yields in a cold country.

Soil drainage.—Drainage is a particularly troublesome problem in areas that have permafrost (permanently frozen subsoil) and in the southeastern Panhandle section where the rainfall is excessive. Tile is prohibitively expensive, and information on tile substitutes is needed, as well as information on the depth and spacing of such substitutes and the effect of open ditches on the different soil types.

Irrigation.—The Tanana and Matanuska Valleys and Kenai Peninsula experience periods, especially in the spring, when rainfall is insufficient for most rapid growth of horticultural crops. Supplying supplementary water for irrigation is an important problem. In some sections, because of permafrost and lack of free water in the subsoil, wells and cisterns are not practicable and the entire water supply for all purposes must be hauled from streams or lakes. Instructions and plans are needed for the construction of storage ponds or lakes. Information on the most economical pumping unit and irrigation system for different areas and the best amount and frequency of irrigation is of importance to many Alaskan horticulturists, especially those in central Alaska and on the Kenai Peninsula.

Fertilizers.—Fertilizer is scarce and expensive. Every farmer is faced with questions of the proper analysis, quantity, method, and time of application of fertilizer for every crop he grows. Many instances were seen of the necessity of using fertilizer for the maximum yields on several horticultural crops. In a few cases symptoms of suspected minor-element deficiency were observed on several vegetable crops. The fertility value and best method of utilizing kelp, other seaweeds, and shells is a problem of importance to all farmers near the coast, especially those in southeastern Alaska. Factors affecting the leaching of mineral nutrients from the soil are important in areas with heavy rainfall.

Weed control.—Weed control is probably one of the most important farming problems in Alaska. In vegetable production it is probably the most expensive operation, as weeds are very bad in all parts of the Territory. Chickweed, lambsquarters, and horsetail are particularly troublesome. Stump and brush windrows are sources of weed seeds that should be cleaned up by some of the chemical weed killers to prevent recontamination of the adjoining fields. Data on the cost and efficiency of the various herbicides are needed.

Quarantine laws.—Agriculturally Alaska is a relatively new area and as such is fortunate in not having all the insects and diseases that attack horticultural crops in older agricultural areas. The recent enactment of a Territorial law establishing quarantine rules and seed regulations for Alaska should be helpful in preventing the importation of harmful diseases, pests, and noxious weeds. It should be rigidly enforced and expanded as necessary to protect the agriculture of Alaska.

Damage by wildlife.—In a pioneer country where such a small part of the total area is cleared and cultivated and where there is an abundance of wildlife, it is to be expected that horticultural crops will be damaged. Early in the spring young vegetables may be damaged by mice, rats, deer, moose, and many kinds of birds. The young shoots of raspberries are the favorite food of deer. In the vicinity of Juneau porcupines almost completely defoliate strawberry plants not covered with wire-netting cages. The wire cages are also necessary to save the fruits from squirrels. Robins on Sitka and white-crowned sparrows on Gravina Island feed so heavily on young vegetable seedlings that planting is deferred until their spring migration is over. Sapsuckers are reported to have killed young apple trees in the vicinity of Ketchikan by their extensive drilling of the branches and trunks.

Insects attacking man.—The control of insects that attack man, causing discomfort if not actual illness, is a serious problem in Alaska. Mosquitoes of several kinds are prevalent throughout most of the Territory and at certain seasons are so numerous that it is necessary to completely cover the body and hands and to wear insect veils in order to work out of doors. "White sox" or blackflies, biting midges or "no-see-ums," and horseflies or "moose flies" are also very troublesome at certain periods of the year.

Electric power.—The development and distribution of electric power is of interest to many Alaska farmers. In isolated communities, wind-driven generators with gasoline auxiliary engines are almost the only possibility. This type of generator should be especially valuable on the Aleutian Islands where the wind movement is rather constant. The presence of coal near Homer and along the railroad belt makes steam-generated electricity possible for users within reach of the power lines. Hydroelectric generating plants are possible in several parts of Alaska. Cheap electricity would make it possible for the horticulturist to use artificial light to advantage in the early starting of garden plants. If available in quantity electricity might even be used for heating hotbeds and small home greenhouses. Electric cold-storage units would make possible the year-round use of frozen foods, which would stimulate the production of fruits and vegetables for this purpose.

Food-processing facilities.—Community or cooperative freezing and canning factories are needed in the Tanana and Matanuska Valleys in order to utilize any temporary periods of overproduction of small fruits and certain vegetables and to stimulate use of them through a greater part of the year. Frozen foods would seem to be especially useful in Alaska since they could be kept frozen for several months without refrigerators or expensive equipment. In both of those valleys several wild fruits that grow in great abundance as well as a number of high-yielding cultivated vegetables might be processed by freezing.

Food-storage facilities.—In the larger consuming centers, community or cooperative storage plants should be constructed. Perishable farm products shipped to these plants during mild seasons could be distributed to local consumers during the winter with little danger of loss by freezing.

HOME GARDENS

Almost every homesteader in Alaska has a garden, and the percentage of town homes with vegetable gardens is higher than in the United States. The prevalence of gardens is probably a consequence of the desire to vary the diet from dry, canned, or dried staple articles, to provide an on-the-spot source of food, and to save money. Fresh vegetables and fruits are very expensive by reason of their perishable nature and the high cost of transportation, but the health value of these products is well recognized. Much credit is due the home demonstration agents and other Extension Service workers of the University for the increase in the number, size, and quality of vegetable gardens.

The sizes of the home gardens vary widely, depending on the area of suitable soil available, the time that can be devoted to their care, the kind and amount of produce desired, and the inclination of the gardener. In the extreme northern section of the Territory and at the higher altitudes where frosts occur almost every month, gardening is sometimes limited to what can be done in coldframes, hotbeds, or small greenhouses. In other areas where there is a market for surplus vegetables, the home garden is limited in size only by the amount of land and labor available. Most of the home gardens, however, are relatively small, probably because of the expense of large areas in the towns and because of the labor and cost of clearing land outside the towns (fig. 62).

Vegetables are predominant in most gardens, although strawberries, raspberries, and flowers and shrubs of many kinds are also common (figs. 63 and 64).

The quality of the gardens seen was exceptionally high and in most cases indicated considerable experience and forethought in planning, in the selection of crops and varieties, and in the details of management. The poor gardens were usually the result of inexperience and failure to follow the advice and recommendations available through Extension Service publications and from experienced local gardeners.

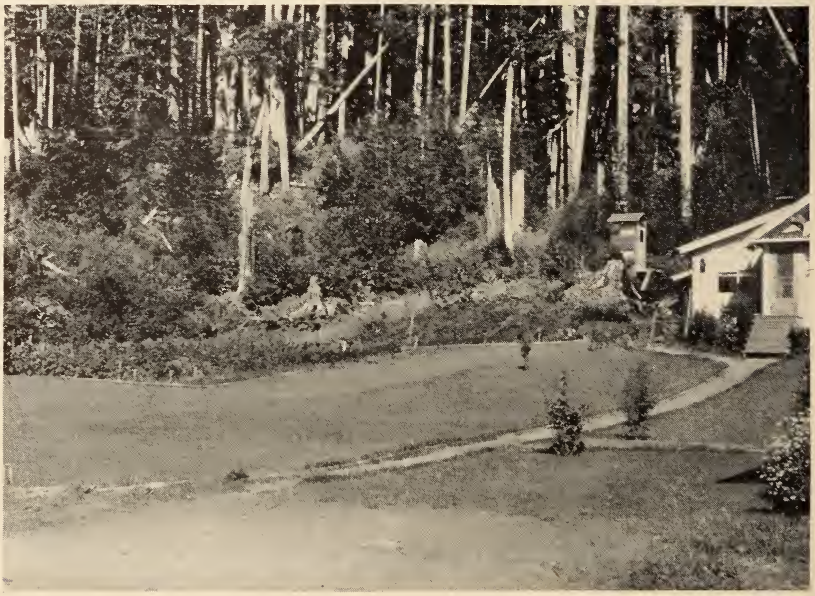

Figure 62.—Small home with fine lawn and vegetable garden (at left) on South Tongass road near Ketchikan. Heavy stands of large timber like that in the background make homesteading difficult and costly in southeastern Alaska.

The kinds and varieties of plants grown and the problems encountered in growing them will be discussed later under headings for the different vegetables, fruits, and ornamentals.

GREENHOUSES AND FORCING STRUCTURES

HOME GREENHOUSES

The newcomer is astonished at the large number of small home greenhouses throughout Alaska. Many are attached to the dwellings and may or may not be heated by the central heating system (figs. 65 and 66. Others, and these are in the majority, are separate from any build-

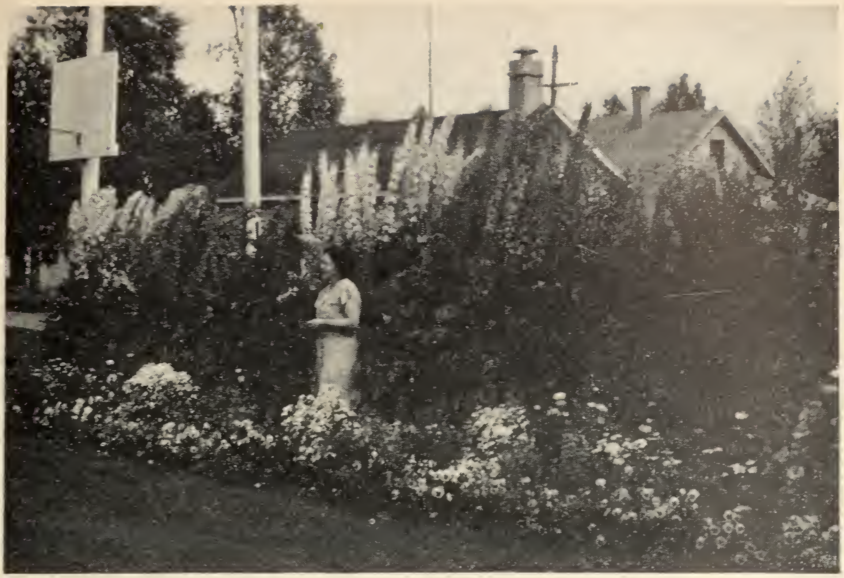

FIGURE 63.—The wife of Judge Pratt, of Fairbanks, in one of her flower borders, showing 8-foot-tall Pacific Hybrid delphiniums.

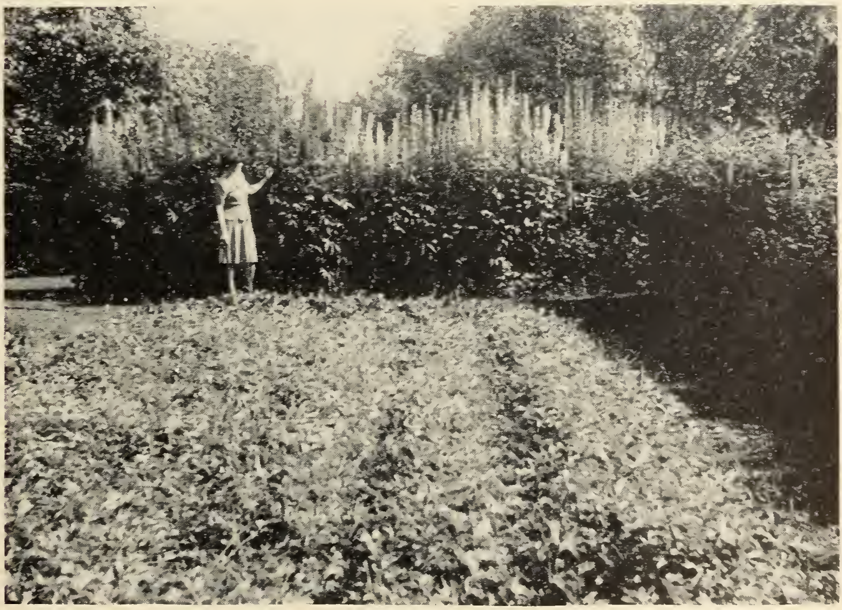

FIGURE 64.—Part of the Clegg garden in Fairbanks, showing delphiniums over 7 feet tall, a fine bed of strawberries in the foreground, and red raspberries almost 6 feet tall on the right.

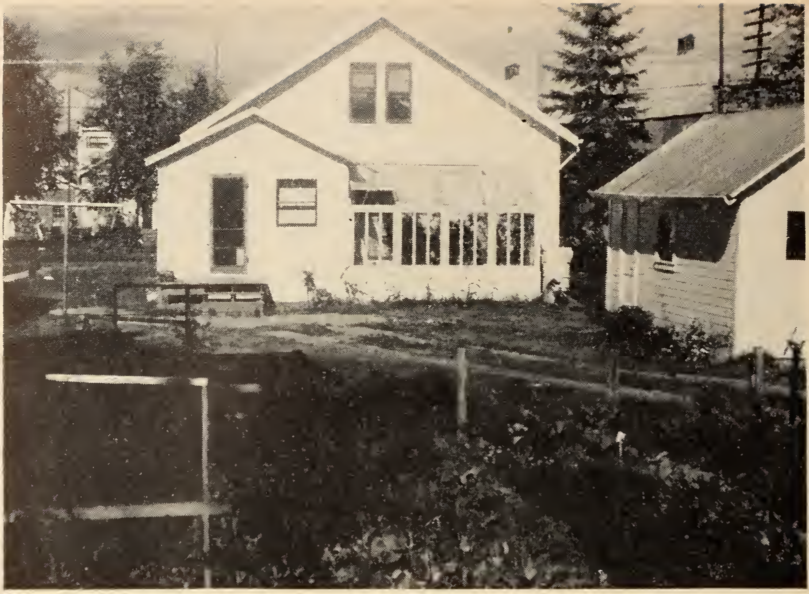

FIGURE 65.—Small greenhouse of the lean-to type in L on the south side of a residence in Fairbanks. Note that the end roof sashes have been lifted to provide ventilation for the tomatoes ripening inside. A few sweet corn plants are in tassel just in front of the greenhouse.

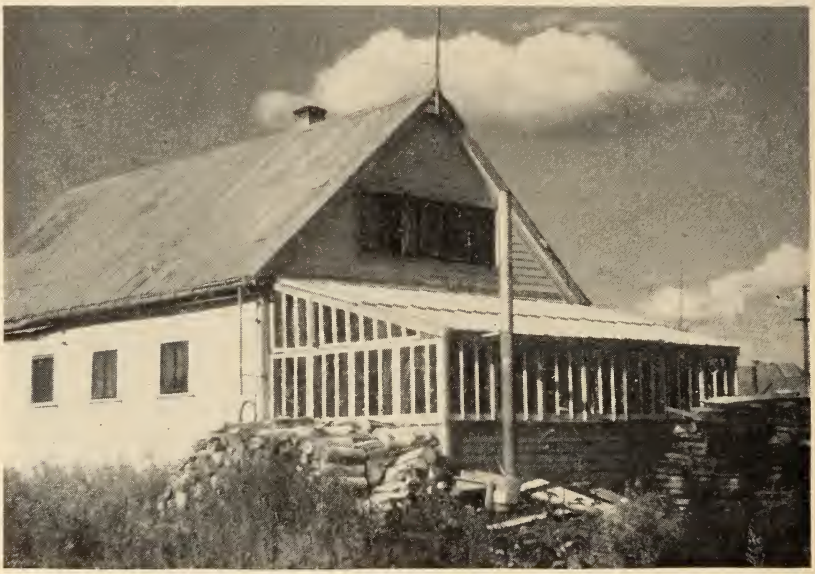

FIGURE 66.—A lean-to greenhouse on the south end of a house in Fairbanks. A wood-burning heating plant is in the basement at the left end of the structure.

ing and have independent heating systems (fig. 67). If a gardener has no greenhouse large enough to stand up in, he will almost invariably have a coldframe or hotbed somewhere on the premises. In the more northern sections and on the Aleutian Islands, protective structures of some kind are desirable, if not necessary, even in the summer, to protect the plants from occasional frosts and strong winds and to raise the temperature enough to make rapid growth of cool-season vegetables possible. In central Alaska, forcing structures are desirable in order to start plants early and thus increase the length of the growing season, to protect warm-season crops from occasional summer frosts and cool periods, and to provide temperatures high enough to mature warm-season food crops, such as tomatoes, cucumbers, and peppers, and roses and other flowers and ornamental plants. Forcing structures are needed in southeastern Alaska to protect the plants from the heavy rainfall of that region.

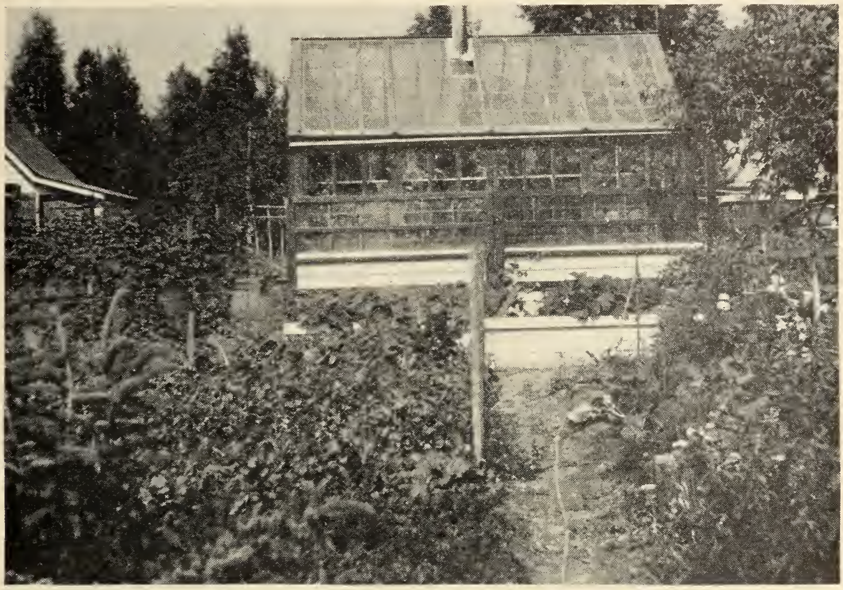

Figure 67.—Separate greenhouse and coldframe in Fairbanks, typical of many found throughout Alaska.

The home greenhouses and forcing structures very greatly in size, design, heating method, kind of building materials used, and in the crops grown. Because of war shortages many of the coldframes, hotbeds, and greenhouses were covered with some kind of glass substitute such as treated cloth or acetate films. By 1946, much of this material had deteriorated so that a new covering was necessary before another crop could be grown. In a few instances standard greenhouse sash (3 x 6 feet) was used on coldframes and hotbeds and in the construction of small home greenhouses (see fig. 67). In other cases storm sash or window frames of various sizes and shapes were used for covering purposes. Since most of the home greenhouses are smaller than 10 by 20 feet, they are usually heated by only one stove. Wood is the most commonly used fuel, although a few coal and oil burners were seen.

Structures high enough for a man to stand up in almost invariably contain tomatoes and cucumbers. A few greenhouses contain sweet peppers, pole snap beans, muskmelons, watermelons, and winter squash. Many contained flowering plants and are used in the early spring for the production of plants for the vegetable garden and flower borders.

COMMERCIAL GREENHOUSES

The number of greenhouses in Alaska producing vegetables and flowers for sale is small, and their total area is inadequate to supply the present demand, even though prices for their products are high. In most cases vegetables, flowers, and early garden plants for outside planting are grown in the same house. The two largest greenhouses in the territory are at Fairbanks (figs. 68 and 69). Each contains 5,000 to 6,000 square feet of floor space principally devoted to the production of tomatoes, although limited quantities of cucumbers are also grown. The Marglobe and Rutgers varieties of tomatoes produced yields comparable to those obtained in the States from spring and summer greenhouse-grown crops.

A number of other growers of truck crops for the Fairbanks market also have smaller greenhouses in which they start their cabbage, cauliflower, celery, brussels sprouts, and flower plants and later follow with tomatoes and cucumbers. Some of the family-size greenhouses also produce a surplus which is sold direct to neighbors or acquaintances or through the local grocer in exchange for staple supplies. One commercial floricultural house was being constructed in Fairbanks in 1946, and a number of home gardeners were contemplating new construction or the enlargement or improvement of their present greenhouses.

Anchorage has two commercial greenhouses smaller than those at Fairbanks. Both are principally engaged in growing flowers. Nearby Matanuska Valley has a number of small greenhouses on truck farms, but since the farmers' association reports no sale of tomatoes or cucumbers, the production of these crops for sale must be negligible. Circle Hot Springs (fig. 70) and Miller House each has a small greenhouse the products of which are used in the dining rooms or sold to nearby mining camps. The Homer area has several small home-size greenhouses from which the surplus might move with other vegetables by air to the naval base at Kodiak. Kodiak has one greenhouse that is large enough to produce a surplus for sale. At Juneau the commercial greenhouses are devoted primarily to flowers (cut and potted plants), although early garden plants of all kinds are grown. The Carter greenhouse at Sitka (fig. 71) contains two hydroponic beds with gravel substrate. When seen, one bed contained a fine crop of ripening Comet-type tomatoes and the other several varieties of roses. At Petersburg a newly erected small greenhouse had a fine crop of Bonny Best tomatoes and Long Green cucumbers, as well as miscellaneous flowering plants and perennial seedlings. Wrangell also has two new small greenhouses, and at least one more is contemplated from which there may be surplus vegetables and flowers for the town's needs. Ketchikan greenhouses containing about 3,000 square feet of floor space with supplementary coldframes are devoted principally to flowers, with chrysanthemums, snapdragons, and asters occupying the largest area. Tuberous rooted begonias, cyclamen, geraniums, double petunias, primroses, roses, and gladiolas, are also grown in smaller quantities.

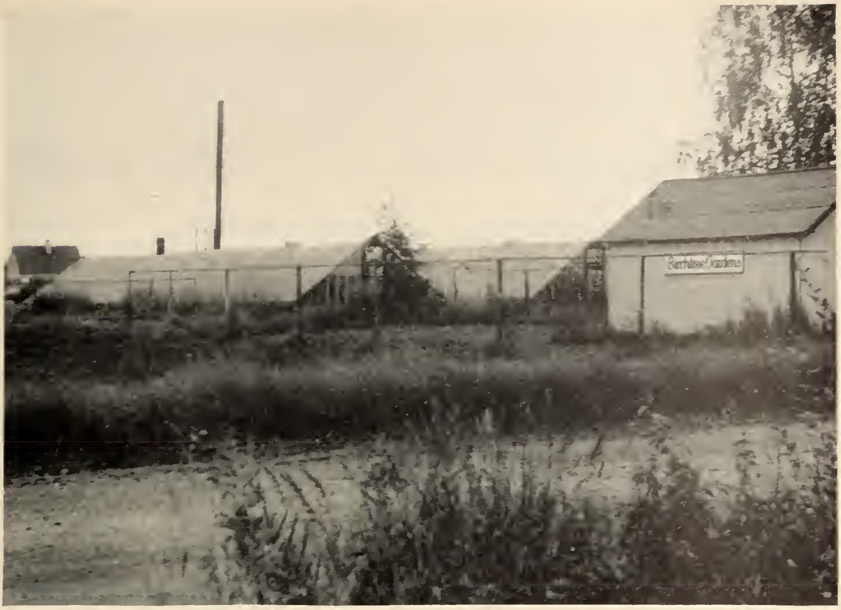

FIGURE 68.—Overhead permanent irrigation system and commercial greenhouses of the Birchtree Gardens in Fairbanks.

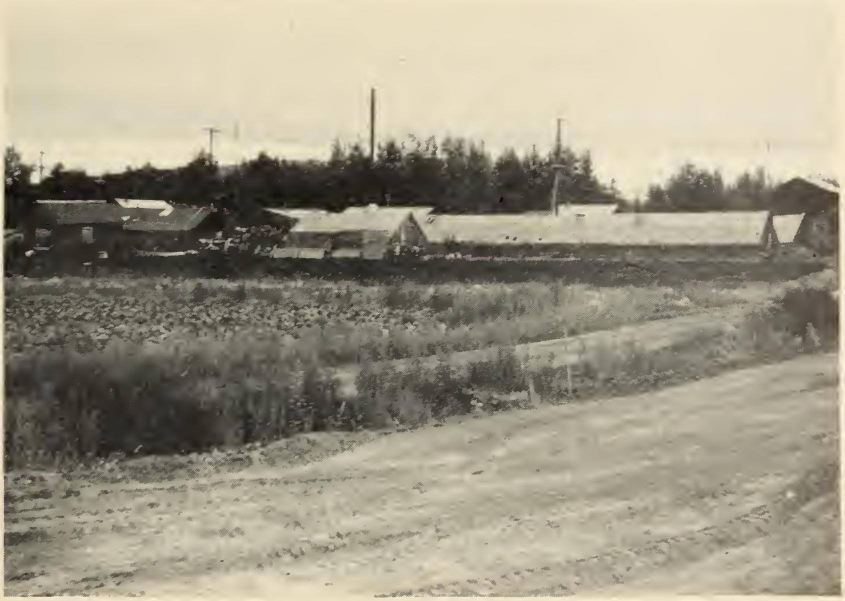

FIGURE 69.—Greenhouses and part of the vegetable gardens of the Fairbanks Gardens in Fairbanks.

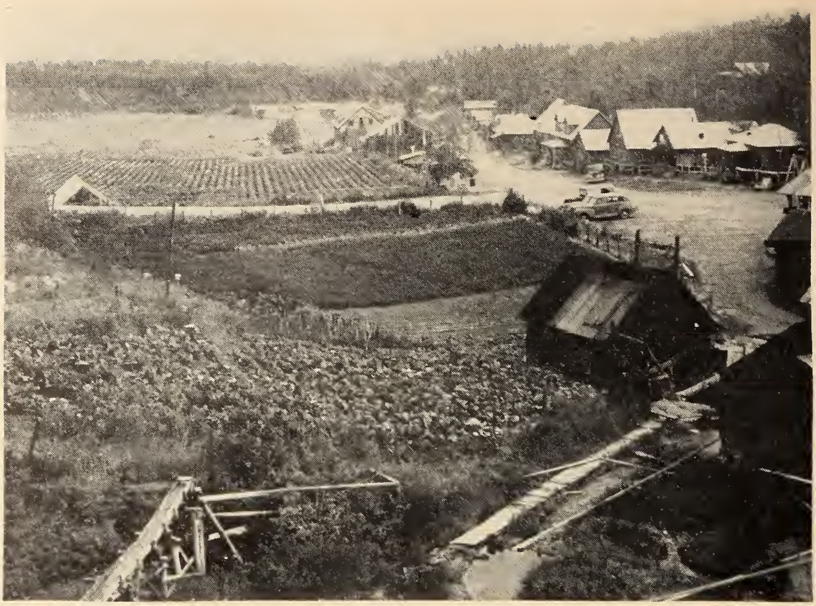

Figure 70.—Garden soil and greenhouse (just beyond road on left) heated by surplus hot water (138° F.) from springs in foreground, at Circle Hot Springs, Alaska.

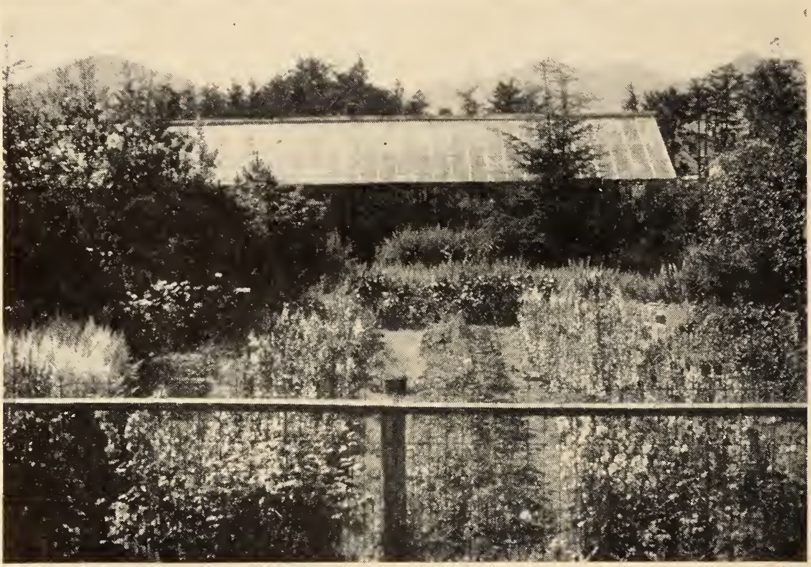

Figure 71.—Flower garden and hydroponic greenhouse in which tomatoes and roses are grown at Sitka, Alaska.

Winter production of vegetables for sale is not feasible because of the small amount of sunlight available and the high cost of heating during below-zero weather.

INSECTS AND DISEASES

In commercial greenhouses containing plant materials imported from the United States are found the usual greenhouse pests such as sowbugs, red spiders, thrips, aphids, and mealy bugs, and the usual control methods are used with more or less success. Small or home-size greenhouses in isolated locations are remarkably free from insect pests in most instances. Root maggots have caused damage when brought into the greenhouse or forcing structure in the soil. Snails and slugs are very troublesome in southeastern Alaska greenhouses and frames.

Though many of the small greenhouses, hotbeds, and coldframes of home gardners are remarkably free of plant diseases, numerous complaints were heard of trouble from damping-off of seedlings in the early spring when the weather was cool, damp, and cloudy. Greenhouse tomatoes were seen that variously appeared to be victims of mosaic, blue mold, mildew, sclerotium rot, blossom end rot, and unbalanced nutrition. Cucumbers were attacked by mosaic, mildew, and sclerotium rot and were affected by unbalanced nutrition.

OTHER PROBLEMS

The builder and operator of a forcing structure of any kind in Alaska is faced with a number of problems on which he may need help based on local research. Some of these will be outlined and briefly discussed.

Location should be considered with reference to accessibility to living quarters, source of central heat and water supply, and protection from winds, snow, excessive rainfall, and floods. The south side of the home or other farm building is a preferred location, and a fence or other windbreak to the windward side is highly desirable.

Size and type depend on the needs of the family or the capital of the commercial operator, the kind of crops or plants to be grown (with special reference to head room required), the ease of working in or around the structure, and the amount of wind and snow to be expected. The lean-to type, tall enough for a man to stand up in and attached to the south side of the home or other building, may be most suitable for homes or other small-sized structures. A modified lean-to or ¾-span type with solid north wall may be most economical for the commercial grower; on a southern slope or hillside the glass span could be wider than on the level.

The kind of light-transmitting material to be used as a covering needs to be determined with reference to first cost, length of usable life, availability, cost of framing, light transmission, heat retention, fireproof nature, and ease of handling sash or frames on coldframes and hotbeds. Under most conditions single layers of glass are best for permanent or semipermanent construction.

The size and kind of heating system to use will depend upon the kind and cost of fuel available, the availability and cost of the firing unit and heat-distribution system, the difference between outside temperatures and inside temperature desired, the necessity for uniformity of temperature, and the size of area to be heated. A wood-burning stove or furnace is most practical for small units in isolated sections where wood is available. Hot water heat is usually preferred in small commercial greenhouses.

The arrangement of the heating system may greatly increase its efficiency. One of the most satisfactory arrangements seen was one in which the wood-burning furnace was located in a pit or basement below an 18-inch layer of dredge tailings or gravel. The smoke pipes were buried in this layer of gravel, which absorbed heat from the pipes and released it slowly to the air surrounding the plant beds just above the gravel. The gravel served as a reservoir of the heat and made possible a relatively uniform air temperature with infrequent firings of the furnace.

Inadequate provision for ventilation was found to be very common both in home and commercial greenhouses. Many of the small-home greenhouses had only one opening for ventilation—the door (fig. 72).

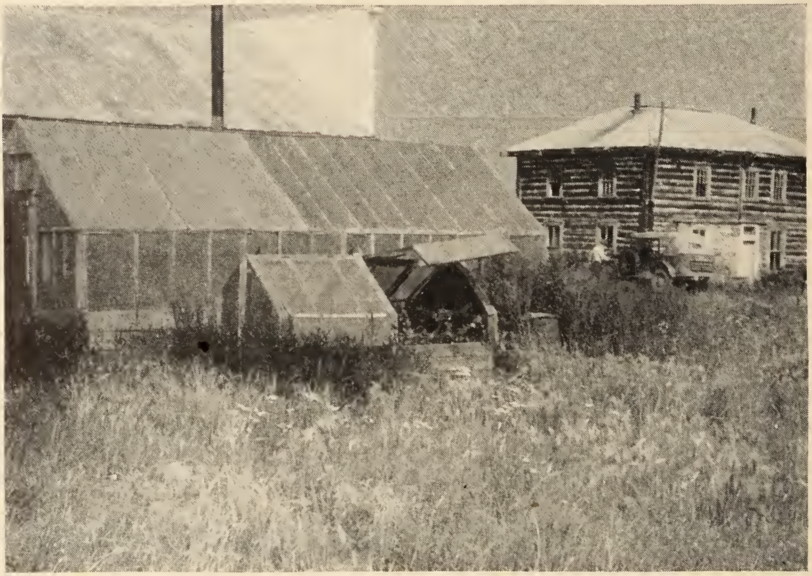

Figure 72.—Coldframe (in foreground) and hothouse constructed of glass substitute and heated by a wood-burning stove in the center. No provision was made for ventilating the hothouse except by opening the door on the left end.

As a result of inadequate ventilation the relative humidity of the air became very high and favored the start and spread of leaf diseases on tomatoes and cucumbers. During periods of bright sunny weather the temperature also became very high in these closed greenhouses and favored the increase of certain diseases and insects.

How to modify the native soil for best growth by combining or composting it with other locally available soils, manures, organic materials, or imported chemical fertilizers is a problem of paramount importance, since most of the soils of Alaska seem to need supplements for optimum growth of plants. Even so, the use of soil instead of water is recommended to amateurs as the best medium for growing garden plants in greenhouses.

The question of whether to use benches or ground beds is of particular importance in Alaska, since most of the greenhouses are allowed to freeze up during the winter months. If the soil is in benches or raised beds it can be thawed more quickly and planting can be started earlier than if ground-level beds are used.

An adequate supply of water, with provision for warming it either by storing at greenhouse temperature or by runing it over the heater or alongside the heating pipes, is a particularly important problem in areas outside the urban supply. Water is hauled by truck for several greenhouses in Alaska. Such a situation limits the expansion of plant production in greenhouses in the Tanana Valley.

The value and proper use of artificial light during the very short days of winter, where electricity is available, need determining. Supplemental light should be beneficial in carrying flowers and propagation stocks through the winter and lengthening the productive period of vegetable greenhouses by making possible the earlier starting of plants.

Information is also needed on the variety or varieties best adapted to the various production sections of Alaska. The present range of varieties used is very great and includes many with low-yielding capacities. If variety tests do not locate varieties especially adapted to the very long Alaskan summer days it may be desirable to start a breeding program to fill this need.

Most of the greenhouse tomatoes appeared too heavily leaf-pruned and most of the greenhouse cucumber plants appeared insufficiently pruned for maximum yields. Experimental evidence on the best methods should be obtained and the information distributed as widely as possible.

VEGETABLE CROPS

POTATOES

The widely grown white, or Irish, potato is the most important single vegetable in Alaska home gardens. Almost every family in the isolated rural areas and many in the smaller towns try to grow at least enough potatoes to carry them over the winter and have some left for seed in the spring. In sections where summer frosts do not occur and the season is long enough to mature the crop, excellent yields of good-quality tubers are produced.

Although the acreage of potatoes per farm rarely exceeds 15 (fig. 73), over 300 acres of potatoes were grown in 1946 in the Matanuska and Anchorage region and over 100 acres in the Tanana Valley. There are smaller acreages in the Homer area (fig. 74) and near some of the towns in southeastern Alaska. The present acreage of potatoes is greater than can be consumed by the civilian population, and plans are under way to supply most of the local military needs. The larger growers are well equipped with power tools and implements to plant, cultivate, harvest, and sort their crops (fig. 75).

Some growers have their own farm storages and others use the storage facilities of the farmers' associations at Palmer and Fairbanks (fig. 76). These associations have storage capacity in excess of a thousand tons each. Storage is usually in bulk. After being sorted and graded, the potatoes are sold in 100-pound burlap bags. Most of the sales are handled by the farmers' association and made to the military services. A number of growers, however, do not belong to the farmers'

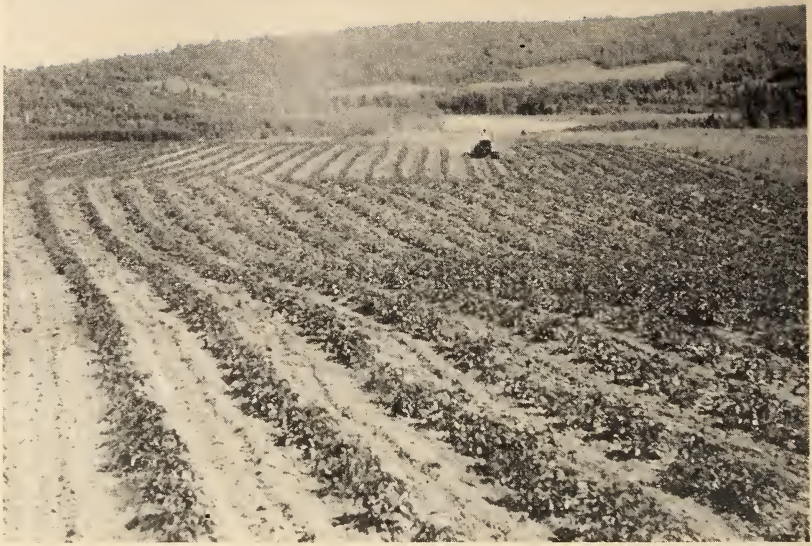

Fig. 73.—Cultivating part of the 14 acres of potatoes on the McGrath farm near Fairbanks with a caterpillar tractor. Note the cleared fields on the lower slopes of the hills in the background.

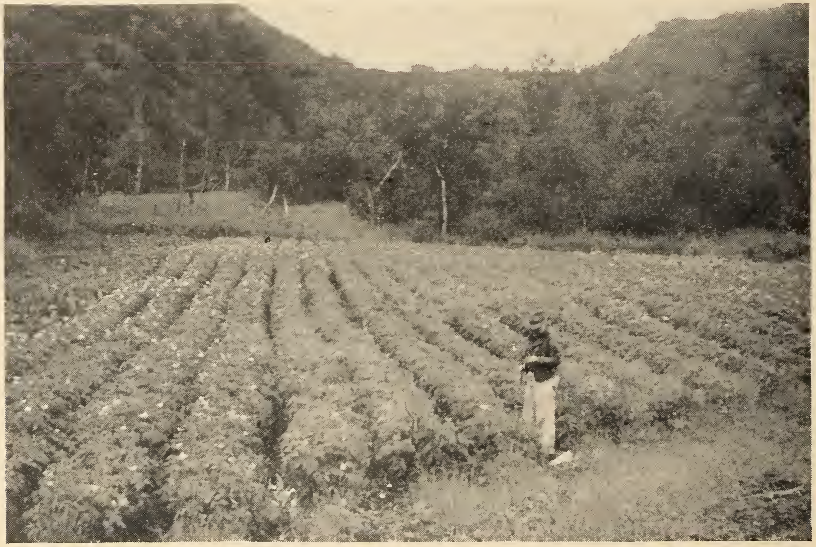

Fig. 74.—Fine crop of Arctic Seedling potatoes on a farm east of Homer. A soil sample is being taken for addition to the U. S. Department of Agriculture world collection.

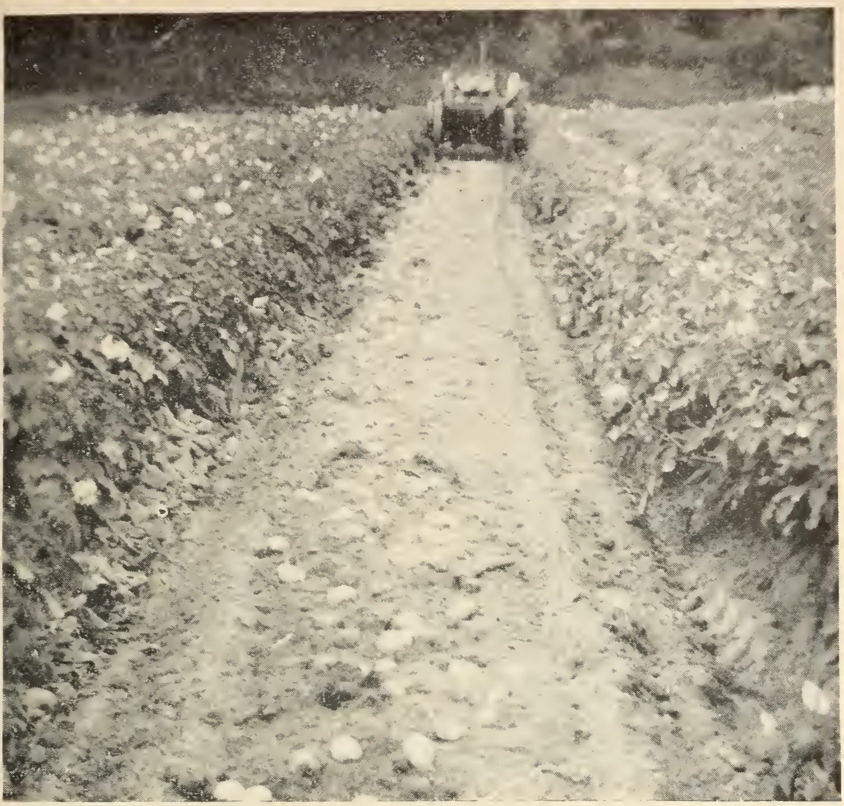

Fig. 75.—Digging potatoes in the Matanuska Valley on August 8, 1946. Wholesale price, $6 per hundred pounds.

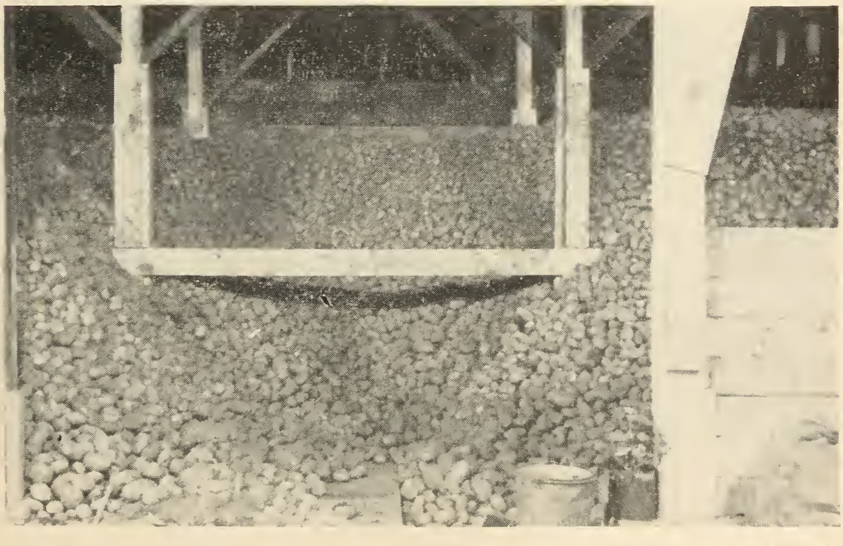

Fig. 76.—Potatoes grown in the Tanana Valley in winter storage in the storage building of the Tanana Valley Farmers' Cooperative Association.

associations and sell direct to individuals, stores, mining camps, and the military services. A recent territorial regulation requiring labeling as to origin (State, or region in Alaska), grade, name of grower or brand, and variety of all potatoes offered for sale is expected to result in an improvement in the quality of potatoes offered for sale and to stimulate the use of Alaska-grown tubers.

Varieties.—A great many varieties of potatoes are being grown in Alaska, but the bulk of the acreage is of Arctic Seedling, Arctic Wonder, Swiss, White Bliss, American Wonder, and Bliss Triumph. The market prefers a smooth, white-skinned tuber. The first four varieties mentioned fall in this classification and are probably local strains of the Green Mountain variety. Comparative-yield trials conducted by the Alaska Experiment Station (fig. 77) during the last 3 years indicate that other varieties may be more productive and that some of them possess disease resistance greater than that of the varieties now most commonly grown.

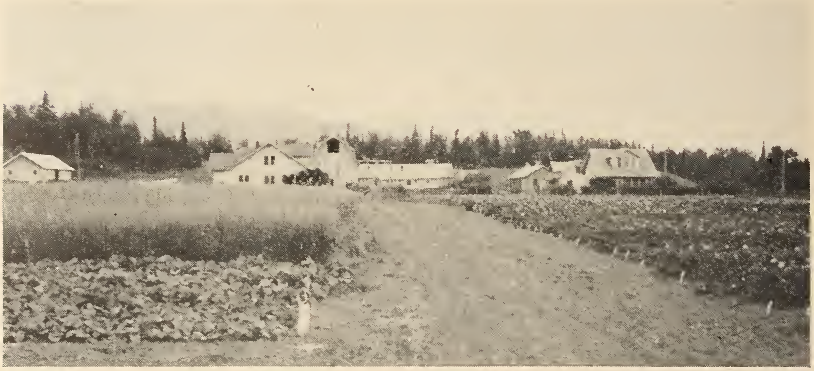

Fig. 77.—Potato experimental plots (on right) and some of the buildings of the Matanuska Experiment Station near Palmer, Alaska.

Seed stock.—Certified seed potatoes are now being produced in Alaska under the supervision of the Alaska Department of Agriculture, and after another year or so sufficient certified seed may be available to meet the needs of local growers and leave some for export to the States. A number of stocks of potatoes that have been in Alaska for many years were found to be eligible for certification. The recently passed Seed and Plant Quarantine Act will tend to prevent the importation of new pests and diseases on seed potatoes (fig. 78).

Yields.—Average yields are reported as 6 tons per acre (200 bushels), but yields as high as 15 tons (500 bushels) per acre have been obtained in favorable seasons under good cultural conditions (fig. 79).

Insects and diseases.—There are no Colorado potato beetles in Alaska, and not enough of the other common insects attack potatoes to warrant spraying for their control, but growers do have to contend with root maggots, which destroy the seed pieces if cut seed is used, and with wireworms. Wireworms have destroyed crops of potatoes in the Matanuska and Tanana Valleys and in the Homer area, but fortunately they occur in damaging numbers only sporadically.

Scab is probably the most important disease of potatoes in the Tanana Valley, but ring rot has recently been found and if it spreads

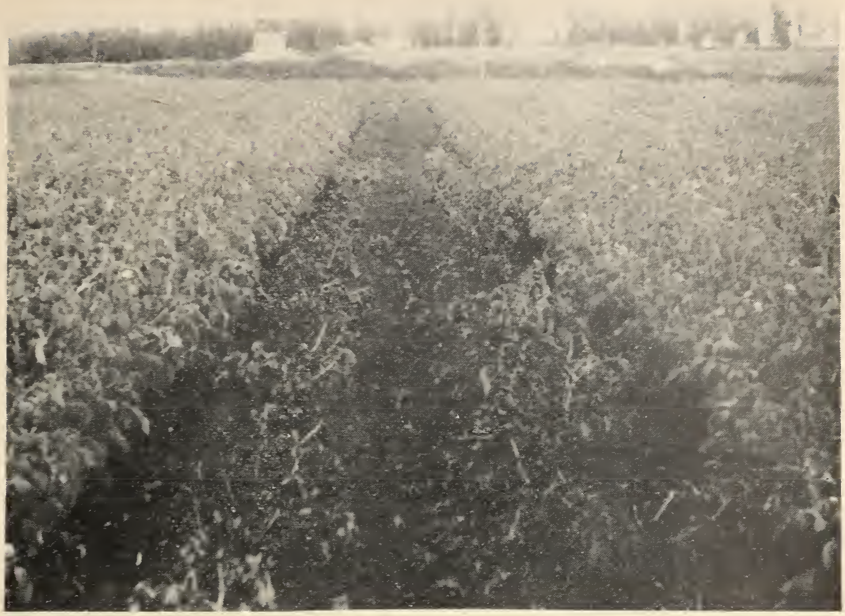

Fig. 78.—The poor growth in the center of this field in the Matanuska Valley was the result of diseased potato seed stock. Compare with the vigorous plants from Alaskan certified seed on each side.

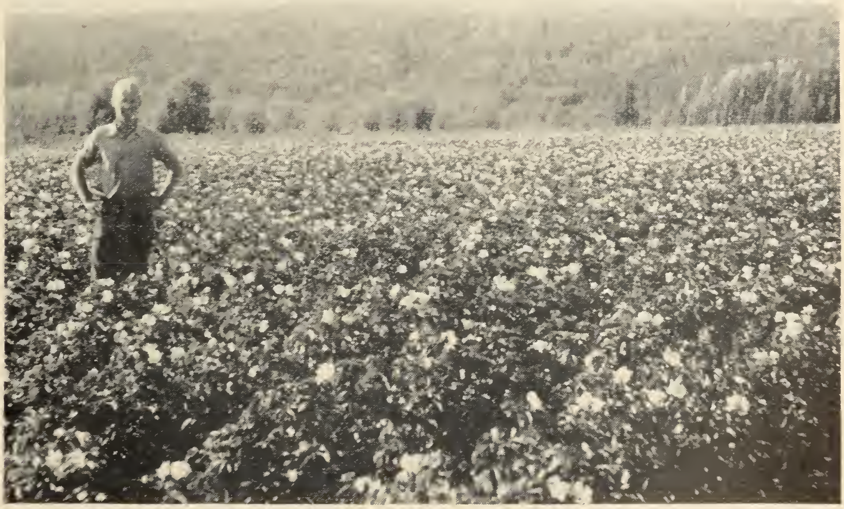

Fig. 79.—Mr. Bert Stimple in his 6-acre field of White Swiss potatoes in mid-July. This field produced approximately 30,000 pounds per acre. The farm is on Farmers Loop Road near Fairbanks. Note the densely wooded, gently rolling character of the landscape in background.

it may soon become the most serious disease. In certain years late blight has caused considerable loss, principally in storage. It was very destructive in southeastern Alaska in 1946. Rhizoctonia and seed-borne viruses are also present in Alaska. Most potato growers in Alaska do not spray or dust for the control of fungus and bacterial diseases on the vines, but they do treat the seed with corrosive sublimate before planting.

CRUCIFERS

The crucifers (cabbage, cauliflower, broccoli, brussels sprouts, kale, kohlrabi, Chinese cabbage, mustard, turnip, rutabaga, and radish) being frost-hardy, cool-season vegetables are well adapted to Alaskan conditions. With potatoes they constitute the most important and most commonly grown vegetables.

Cabbage.—Home gardens throughout most of Alaska contain cabbage as one of the staple vegetable crops, since it may be used fresh in salads, as a pot herb, preserved as sauerkraut, or stored over winter in pits or cellars for use as a fresh vegetable. A rather complete range of varieties was seen, from the very early Jersey Wakefield and Golden Acre, through the midseason Glory of Enkhuizen and Marion Market, to the late Danish Ballhead and Late Flat Dutch. Savoy and red cabbages were also seen, and all varieties commonly listed in American seed catalogs seem to be well adapted in Alaska.

The early varieties of cabbage are usually started in greenhouses or hotbeds and transplanted into the garden as soon as possible in the spring. Midseason and late varieties, in regions with a short growing season, are also started in a forcing structure of some kind. In the central and southern sections cabbage can be matured from seed planted in place in the garden in early May in most seasons. Heads of unusually large size (20 to 40 pounds) can be grown by using the later and larger varieties (Glory of Enkhuizen and Late Flat Dutch) with wide spacing and heavy fertilization and irrigation. The quality of Alaska-grown cabbages is excellent.

Commercial acreages of cabbage are grown in the Tanana and Matanuska Valleys, in the Homer area, and near some of the towns of southern Alaska. It is estimated that cabbage was grown on approximately 20 acres in 1946 in the Matanuska Valley, on 10 acres in the Tanana Valley, and on 10 acres in all the other commercial areas. Forty acres did not produce all the cabbage desired, and if proper storage facilities were provided so cabbage could be available over a greater part of the year, the acreage could be expanded several times without overloading the present market. Yields are comparable to those obtained in the better sections of the United States.

Cauliflower.—Cauliflower is another very common vegetable in home gardens throughout Alaska and may be matured throughout the summer by starting plants at 10-day intervals until the first of June. The Snowball type is the only one recommended, as the winter cauliflowers fail to mature in Alaska. The size and quality of the curds or heads produced vary with the fertility of the soil and the care given the crop but would rate good to excellent.

Commercial acreages of cauliflower are grown in the same areas of Alaska as cabbage, but the total acreage is not as large. The heads are usually trimmed close and packed in lettuce crates with white paper between the layers. For airplane shipments from Homer, corrugated paper boxes holding one layer of six heads are used.

Broccoli and brussels sprouts.—Many home gardens from the Tanana Valley southward contained well-grown plants of broccoli and brussels sprouts in 1946. Calabrese or Early Green Sprouting broccoli and Long Island Improved brussels sprouts were the only varieties seen, but these were very satisfactory when planted early enough to mature. The harvest season of brussels sprouts is too short to produce yields as large as those on Long Island, but the yields and quality were very satisfactory.

Neither of these vegetables is produced in large commercial quantities, although some broccoli was grown for sale in the Matanuska and Tanana Valleys in 1946. The amount of hand labor required to pick, trim, and pack brussels sprouts will no doubt limit expansion of this crop.

Kale and kohlrabi.—Relatively few home gardens grow kale or kohlrabi, but both are well adapted to most parts of Alaska. Siberian and Scotch Curled (either dwarf or tall) kales are the preferred varieties for table use. Thousand Headed kale is sometimes grown as green feed for chickens. White Vienna or Purple Vienna are the commonly grown varieties of kohlrabi.

Very little kale or kohlrabi is grown for sale, probably because there is little demand.

Turnips and rutabagas.—Turnips or rutabagas are grown in most gardens in Alaska and grow to very large size on fertile soils when well cared for. The flat varieties of turnips were frequently seen in the early crop, although the most popular white-fleshed sort was Purple Top White Globe. Yellow-fleshed turnips are more commonly grown in Alaska gardens than in the States. The most sought-after variety was Petrosky, which possesses resistance to damage by root maggots. Most of the lots of so-called Petrosky turnips seen proved to be Amber Globe. Yellow-fleshed rutabagas were more popular than white-fleshed ones, with American Purple Top the most common variety. A number of varieties popular in Canada are also grown.

Market gardeners and truck-crop growers near the towns all had small plots of early turnips (usually flat varieties) that were tied in bunches for sale. The late-sown crops are sold without the tops. The total acreage is not large, although this is a staple vegetable and produces yields comparable to those in the States.

Radishes.—Radishes grow very quickly in the long summers of Alaska and are of excellent quality. They are one of the standard salad vegetables and in great demand by the home gardener and on the market. The small round red varieties were most frequently seen, but French Forcing, White Icicle, and some of the winter storage varieties are also successfully grown.

Most local markets require that radishes be tied in bunches with the tops on. The armed services preferred the radishes in bulk with most of the foliage cut off and in 1945 purchased over 21,000 pounds from the Matanuska Valley Farmers' Cooperative Association alone. They would have purchased more if they had been available. The association also sold over 16,000 bunches of 10 radishes each in 1945.

Chinese cabbage and mustard.—Very few Alaska gardens contained either Chinese cabbage or mustard, although both grew well wherever seen. Chihili was the most common variety of Chinese cabbage, and the curly-leaved mustards were most used. The longstanding or slow-bolting varieties of mustard would be most useful, since they would not bolt, or shoot to seed, as readily under the long Alaska days.

Insects and diseases.—Root maggots are prevalent throughout most of Alaska and are present in damaging numbers almost every year (fig. 80). Most growers of the crucifers treat their plants with corrosive sublimate or calomel, although some sow thickly in the field and do not thin until after most of the damage has occurred. Cutworms are also very destructive at irregular intervals. Wireworms are present in the Tanana Valley but have not yet become serious pests on cabbage or other crucifers. Other potentially injurious insects on crucifers in Alaska are the turnip psyllid, springtails, striped flea beetle, red turnip beetle, vegetable silphid, and cabbage curculio. The green cabbage worm was seen only at Wrangell.

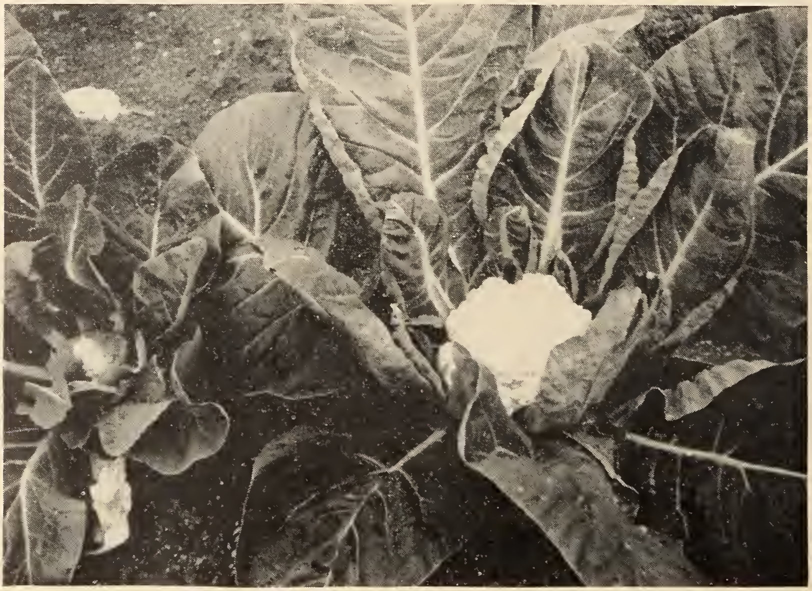

FIGURE 80.—Right, 8-inch head of Snowball cauliflower in mid-July; left, smaller head dwarfed by the cabbage root maggot.

Most of the crucifers seen were relatively free from destructive diseases. Clubroot was seen only at Wrangell. Spraying or dusting of crucifers to control diseases or insects is rarely necessary in Alaska.

Other problems.—Aside from insect control, the chief problem with cabbage is the necessity for storage for short periods in the summer to prevent temporary gluts on the market and storage during the winter to lengthen the marketing season.

With cauliflower, the chief difficulty is premature heading, or "buttoning." This failure to make a head of marketable size may be caused by stunting of the young plants by root maggot damage, clubroot, frost or chilling, insufficient fertility, or insufficient moisture for rapid growth. Yellowing or purpling of the surface of the head, caused by failing to tie the leaves over the heads or to cover them in some other manner early enough, is common.

Cold-storage facilities for increasing the length of the marketing season for both broccoli and brussels sprouts would be helpful in expanding the production and consumption of these vegetables.

Storage of turnips and rutabagas in the northern sections of the Territory is a problem of major importance. Another problem with the late crop is to prevent the roots from becoming too large. Broadcasting the seed thickly or close planting in the row with the rows close together is practiced to prevent turnips from getting larger than 4 inches and rutabagas larger than 6 inches in diameter—the maximum sizes desired on the market.

With radishes, the chief problem, aside from root maggots, is finding the hand labor necessary to pull, bunch, tie, and wash the roots. Few of the growers had the power to run power-driven tyers or the capital with which to purchase such equipment.

LETTUCE

Either leaf, head, or cos lettuce is grown in almost every Alaskan garden. In the more northern sections of the Territory it is usually started in hotbeds or coldframes and in some locations must be grown to usable size in forcing structures of some kind in order to protect it from frost damage. In the Tanana Valley and south of there all kinds of lettuce grow well, and excellent head lettuce may be grown throughout the summer provided adequate moisture and fertility are supplied. Black-Seeded Simpson is probably the most popular leaf lettuce, although Grand Rapids, Early Curled Simpson, and Prize Head are occasionally seen. Almost all the head lettuce is of the crisp type, although the butterhead type is equally well adapted. Most of the crisp type is of the New York and Imperial classes. Gardeners, both home and commercial, are experimenting with a number of varieties or strains and succeeding with a large number. Probably the most universally liked is Great Lakes, primarily because of its tipburn resistance. New York 515 and 615 are also very popular strains. White Paris cos or romaine is the most popular variety of the cos type.

Lettuce is grown for sale on probably as many acres as cabbage, most of it in the Matanuska and Tanana Valleys. The bulk is sold to the military establishments at Anchorage and Fairbanks. Growers at Homer ship part of the head lettuce requirements of the naval base at Kodiak to them by air freight, packing the closely trimmed heads in strawboard paper cartons. The Matanuska and Tanana valley crops are also closely trimmed and are packed without ice in wooden crates holding three dozen heads each. Small market gardeners near the larger towns closely trim their lettuce and deliver it to the local grocer in second-hand baskets or crates. The flavor and texture is excellent, but the heads are sometimes lacking in solidity owing to the haste of the grower to get his lettuce to a high-priced market. Leaf lettuce is produced commercially in limited quantities to reach the market before head lettuce is available locally, to fill in the gaps between crops of head lettuce, or in case head lettuce is ruined by tipburn. The production of lettuce could probably be profitably increased, since Alaska now uses more lettuce during its production season than it produces.

Insects and diseases.—Insects cause very little damage to lettuce, although cutworms and slugs are troublesome in some seasons and localities. In southeastern Alaska, earthworms sometimes crawl up into the heads.

The control of tipburn and slime on head lettuce through the use or development of a resistant variety (fig. 81) or through irrigation, soil fertilization, and cultural means is the most important disease problem of the lettuce grower. Seed-borne mosaic has been seen, but since insect vectors are present in very small numbers if at all, it is not now an important problem. Damping-off of the seedlings is a cause of heavy loss in certain seasons.

Other problems.—Finding a reliable source of good seed of an adapted variety is one of the primary problems of the lettuce grower. He also needs to know how to prolong his production season. This may be done by an earlier start through use of transplants grown in a greenhouse, by planting in the fall for overwintering, by extending the season by using frost-hardy strains, or by storage under controlled conditions.

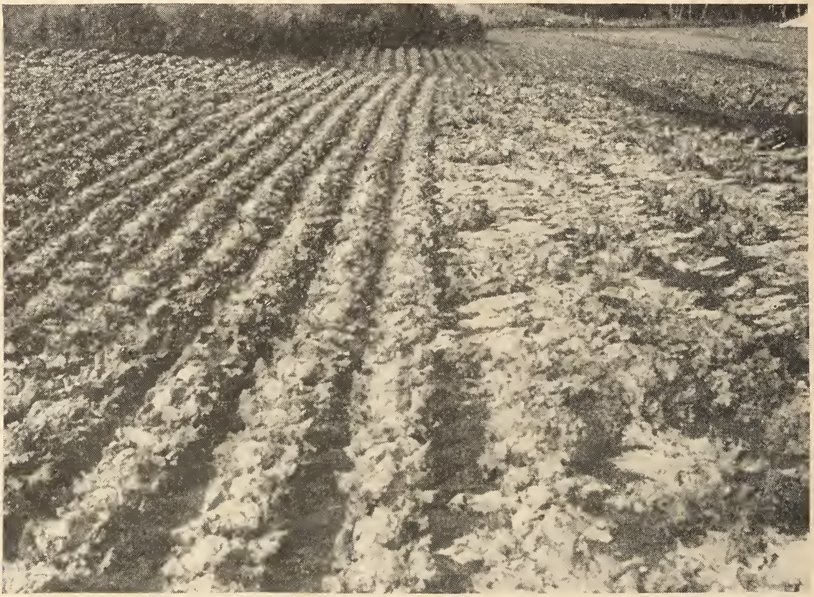

FIGURE 81.—Variety is important in head lettuce production in Alaska. No heads were harvested from Imperial 44 on the left because of tipburn and slime, whereas most of the Great Lakes plants on the right produced marketable heads. (Matanuska Valley, 1946.)

CARROTS

Carrots of excellent quality may be grown in most of the gardens of Alaska. Above the Arctic Circle or in cold locations it may be necessary to grow the very early varieties, French Forcing or Scarlet Horn, in coldframes or sheltered locations; but in the Tanana and Matanuska Valleys, and farther south, Chantenay, Nantes, Long Chantenay, and Danvers Half Long mature fine crops on the sandy loam soils. The muskeg soils of southern Alaska will also grow fine carrots if well drained, limed, and fertilized properly.

Carrots are one of the commercially grown crops in great demand by the armed forces. During the summer carrots are sold in bunches, each bunch usually containing six roots (fig. 82). In the fall the tops are cut off and the roots sold by the pound in baskets, crates, or burlap bags. They are usually stored in root cellars and sold throughout the winter. On fertile soil, unless carrots are planted thickly the roots may become too large for table use. Yields in excess of 10 tons per acre are not unusual, and there is a ready market for more carrots than are now being grown.

Insects and diseases.—At the present time the growing crop seems to be free of injurious insects and diseases. Rots in storage may cause loss unless care is taken in harvesting the roots, maintaining proper temperature and humidity in storage, and disinfecting the storage house or cellar.

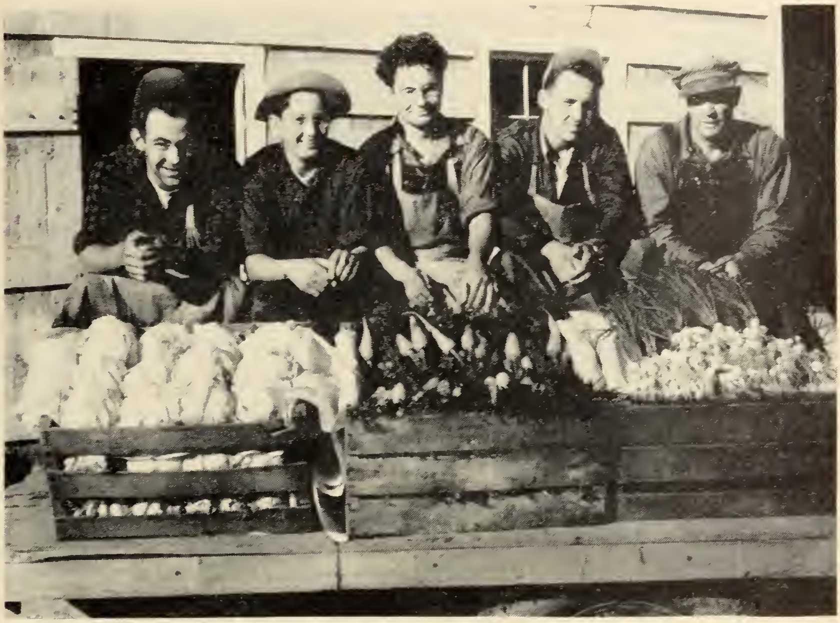

FIGURE 82.—Matanuska Valley vegetables and vegetable growers.

Other problems.—One of the main problems in carrot production is the control of weeds. The use of herbicide sprays may help in this. Finding the hand labor to pull, tie, wash, and pack the bunched roots is difficult at present, and proper storage facilities for holding the crop over winter are often lacking.

CELERY

Celery is more successful in the interior than along the coast and in warm summers than in cold wet summers. It is not as popular in home gardens as lettuce or cabbage, because the seed is difficult to germinate and the young plants grow so slowly that they must be started in greenhouses or hotbeds. Where plants are available from commercial growers, home gardeners are able to grow fine-quality celery in most seasons.

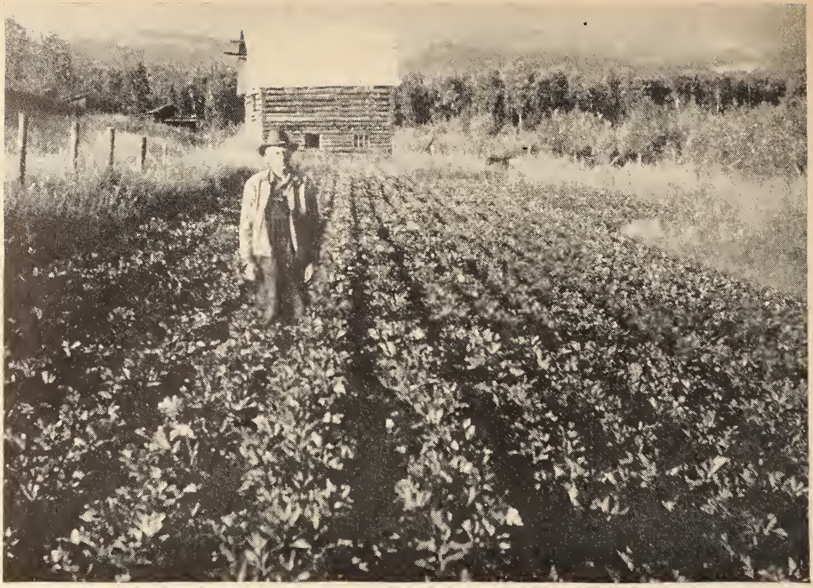

FIGURE 83.—A fine patch of Jumbo Utah celery in mid-August in the Matanuska Valley.

Celery is an important commercial crop in the Tanana and Matanuska Valleys and in the Homer area. The entire commercial crop is of the green Summer Pascal or Utah Green type and is sold without blanching, with light trimming, and usually by the pound. The trimmed plants weigh between 2 and 3 pounds each. By close planting very high yields per acre are obtained by the more experienced growers (fig. 83).

Insects and diseases.—Damage from insects and diseases has been so rare that dusting or spraying has not been necessary. Early blight (*Cercospera apii*) was found in one field in the Matanuska Valley in the summer of 1946 where overhead irrigation had been practiced. If the blight becomes widespread a dusting or spraying program may be necessary to control it.

Other problems.—The formation of seed stalks before the plant reaches market maturity is one of the principal problems of the celery grower in cool seasons. This can be partially solved by the development of slow-bolting or nonbolting varieties. Earlier maturing and better storage varieties are needed to lengthen the harvesting period.

ONIONS AND RELATED PLANTS

Onions, especially green onions, are in great demand and grow well in many parts of Alaska. Dry sets are commonly used in the small home garden to produce green onions; if allowed to develop to maturity, they make fair-sized dry onions. Ebenezer onions, 1½ to 2½ inches in diameter and maturing in late July and August, were seen from Fairbanks southward. The foliage was relatively small, considering the size of the bulb, but the bulbs were well-formed, firm, and reported to keep well if properly dried and stored.

Pink garlic also makes medium-sized, firm bulbs with very small foliage that dies down by mid-August.

Small (1- to 2-inch diameter) but firm, dry bulbs of a yellow or copper-colored shallot or bottom-multiplier onion are common in gardens in the Tanana and Matanuska Valleys. This type of onion or shallot was ready to pull and dry by mid-July and furnished early green onions when set out in the early spring. The period during which it could be used for green onions was relatively short, as the outer layers soon became tough and yellow.

The most popular variety of early green onions is known variously as White Welsh, Nebuka, White Bunching, or Evergreen White Bunching. This is a nonbulbing variety which, when sown in the late spring and hilled up during the summer cultivations, produces long, slim, white onions that can be marketed as soon as new growth starts the following spring. Early spring sowings of White Portugal, Southport White Globe, Crystal Grano, Early Grano, and White Sweet Spanish also are used for the production of green onions during the spring and summer (fig. 84). Late (mid-May) and thick sowings of the Ebenezer and Yellow Globe Danvers varieties made small bulbs or sets that could be dried under cover and stored for spring planting, to be used as green onions or allowed to mature for dry onions.

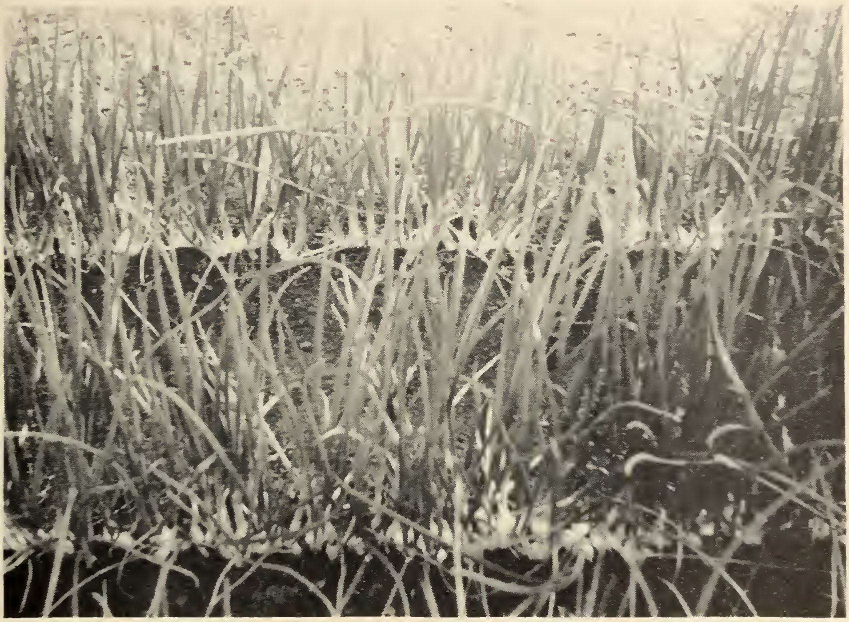

FIGURE 84.—A fine crop of green bunch onions from spring-sown seed grown in the Matanuska Valley of Alaska. They are worth 1 cent each at wholesale.

Leeks and chives were seen in very few gardens but in all cases were of good size and quality.

Small acreages of green onions are grown for sale in the Tanana and Matanuska Valleys, in the Homer area, and near most of the larger towns. The total acreage is not large but it is an important item in the income of truck-crop growers, since a good stand may return as high as $3,000 to the acre.

Insects and diseases.—No diseases or insects were noticed as injurious to the growing crops of onion or its relatives. Neck rot, however, was reported to cause heavy losses in bulbs to be stored for winter use unless they were dried rapidly under cover and stored in a dry, cool place.

Other problems.—The principal problem in the production of green onions for market is the large amount of hand labor required in weeding, pulling, bunching, tying, washing, and packing the crop. In the case of dry onions, the cost of sets or the expense of growing, curing, and storing sets and the difficulty of quickly drying or curing the mature bulbs and storing them over winter are difficulties that will probably prevent the successful commercial production of dry onions. Weed control in onions is very difficult since the seedlings are so small, grow so slowly, and do not shade the ground, which would help to control weeds.

BEETS AND CHARD

Beets and chard were grown successfully in Alaska in gardens south of the Arctic Circle in 1946, but in almost every garden both crops were shooting to seed by midsummer. This production of seed stalks did not occur in most cases until after the plant had attained usable size, but it was an indication that the average temperatures during the early part of the season were close to those that induce seed-stalk formation. During cold, wet, spring weather, beets and chard could be expected to thrive only in the warmer locations in the interior valleys. Lucullus and Dark Green Lucullus were the most popular varieties of chard, while Crosby Egyptian, Early Wonder, and Detroit Dark Red were the most popular beet varieties.

Commercial acreages of beets and chard are very small in the Tanana and Matanuska Valleys and at Homer. The first beets are sold in bunches of four to six each, but later the tops are cut off and the roots sold by the pound in baskets, boxes, or burlap bags. Chard is tied in bunches and sold by the pound. Yields of both vegetables appeared to equal those produced in the States.

Insects and diseases.—Beets and chard seemed to be relatively free from diseases and insects, although the spinach webworm has caused some damage in the Matanuska Valley in the past. Other insects which may eventually become troublesome are the spinach leaf miner, striped fleabeetle, and aphids.

Other problems.—Resistance to bolting, or seed-stalk formation, under Alaska conditions is a problem needing solution and one for the seedsman and plant breeder.

SPINACH

Only the late or long-standing varieties of spinach, such as Long Standing Bloomsdale, Nobel, or King of Denmark, are suited to Alaska because the earlier varieties bolt before they reach marketable size under the cool temperatures and very long summer days. Both savoy and smooth-leaved types are grown, with the smooth-leaved varieties preferred because they are easier to wash. New Zealand spinach made excellent growth in 1946 in the Tanana Valley and may be an acceptable substitute for spinach in the summer.

Spinach has little prospect of becoming commercially important because of its short period of vegetative growth from the early spring sowings.

Insects and diseases.—Spinach webworm has caused slight damage in the Matanuska Valley. Although it has not yet been observed feeding on spinach in the Matanuska Valley, the spinach leaf miner is present there. No destructive diseases have been noted on spinach.

Other problems.—Most of the wet soils of southern Alaska are too acid to grow spinach, and because of their organic nature very large amounts of lime would be required to make them suitable. Fall sowing might be a partial solution of the bolting problem, but the breeding of longer standing varieties than are now used would be of more permanent value.

PEAS

Garden peas thrive in all sections of Alaska where the period between killing frosts is long enough for them to mature. Size of pod and plant is unusually large, and since most main crop varieties can be harvested throughout most of the summer the yields are likewise very large. Quality is excellent. Many varieties are grown successfully, but the most popular for market and home gardens is the large-podded Alderman or Dark-Podded Telephone. The plant is tall and must be supported by poles, a trellis, or other support. In many gardens the plants were 7 feet tall by mid-August and still producing heavily, with pods 5 inches or more in length.

Very few peas are grown for market. Most of those on the market are the surplus from home gardens. At one time there was a small pea-canning industry in the Matanuska Valley, but it seems to have failed because faulty procedure resulted in poor quality of the canned product. Yields of 1,500 to 3,000 pounds of shelled Alaska peas per acre have been obtained from experimental plots at the Matanuska Experiment Station. Yields of this magnitude would seem to indicate that a profitable pea-canning or pea-freezing industry might be developed in this Valley. The pea crop would fit well in the dairyman's rotation, and the vines produce valuable feed for the cows either as silage or as hay.

Insects and diseases.—Cutworms and slugs are the principal insect pests of the pea crop, although aphids are present and may become troublesome in time. Mildews and leaf blights are very prevalent in southeastern Alaska and unless controlled cause a complete failure of the crop.

Other problems.—The high cost of seed is a deterrent to expansion of pea growing either for the fresh market or for processing. The high cost of labor for picking at the present time also limits the quantity of peas grown for the fresh market. The principal problem in the development of a processing industry is the securing of experienced personnel to supervise the operations involved.

RHUBARB

Rhubarb seems to be well adapted throughout Alaska, and well-grown plants were observed in all sections visited. The size and excellence of the growth varied with location, fertility of the soil, and care given the planting, but in general the growth and yield were excellent. In many cases the stalks were almost entirely green or only slightly tinged with red, indicating that the variety was probably Victoria or the plants were divisions from a green seedling. The Canadian variety MacDonald made excellent growth but was not as well liked as Strawberry or Cherry, because it toughened and became stringy earlier.

Almost every home garden grows a few plants of rhubarb, and in the Matanuska and Tanana Valleys commercial quantities are grown for the market. The stores in the towns of southeastern Alaska also had rhubarb for sale in the spring, mostly the excess from home gardens or from a local market gardener.

No destructive insects or diseases were observed.

BEANS

Bush snap beans are commonly grown in home gardens in the Tanana and Matanuska Valleys, and in sheltered locations and in warm seasons are quite successful. Only the earliest varieties, such as Bountiful and Golden Wax, are successfully grown. In southeastern Alaska, the weather is too cool and rainy for snap beans but is suited to Broad beans (*Vicia faba*) or English dwarf beans, or Broad Windsor beans. Gardeners growing Broad beans are usually of recent European origin, as few gardeners from the States know how to grow or cook them. Lima beans are not adapted to Alaska conditions.

The growing of bush snap beans for market is too uncertain an undertaking, and the few snap beans seen in the stores were usually the surplus from some local home garden.

No destructive insects or diseases were noted on beans.

TOMATOES

Tomatoes are in great demand in Alaska and are grown in almost every greenhouse and in many gardens in the Tanana and Matanuska Valleys. Very few tomato plants were seen out-of-doors in the Homer area or in southeastern Alaska, probably because the low temperatures prevented normal growth and ripening. Field-ripened fruits were observed in the Tanana and Matanuska Valleys during the warm dry summer of 1946, but the number was small before the frost of mid-August stopped further growth. Victor, Bounty, and Firesteel were the most promising varieties seen. It is possible that breeding can produce a variety more nearly adapted to the low temperatures and long days than any now available.

See discussion under Greenhouses and Forcing Structures for insect and disease problems with tomatoes.

VINE CROPS

The vine crops (cucumbers, melons, pumpkins, and squash), being warm season vegetables, are not generally successful in Alaska gardens. If started in the hotbed or greenhouse and then transplanted into the garden, the earliest varieties of cucumbers and summer squash will produce a limited number of fruits in protected locations and in the warmer seasons in the interior valleys.

In a few cases, mature fruits of Hubbard winter squashes have been produced, but most of the squash are of the summer varieties Zucchini, White Bush Scallop, Yellow Crookneck, or Giant Straightneck. Several hundred pounds of Zucchini squash were marketed by the growers in the Matanuska Valley in 1946.

Cucumbers are sometimes grown in cold frames and hotbeds after the young vegetable and flower plants have been set into the gardens. One grower in the Tanana Valley successfully grew cucumbers out-of-doors by growing them in steel barrels, where the sun warmed the composted soil enough to give growth (fig. 85).

Muskmelons and watermelons were seen only in greenhouses, where they were grown as a novelty.

Insects and diseases.—Insects and diseases were not troublesome on the few garden vine crops seen. Mildew was prevalent on the summer squash in southeastern Alaska but seemed to be doing little damage.

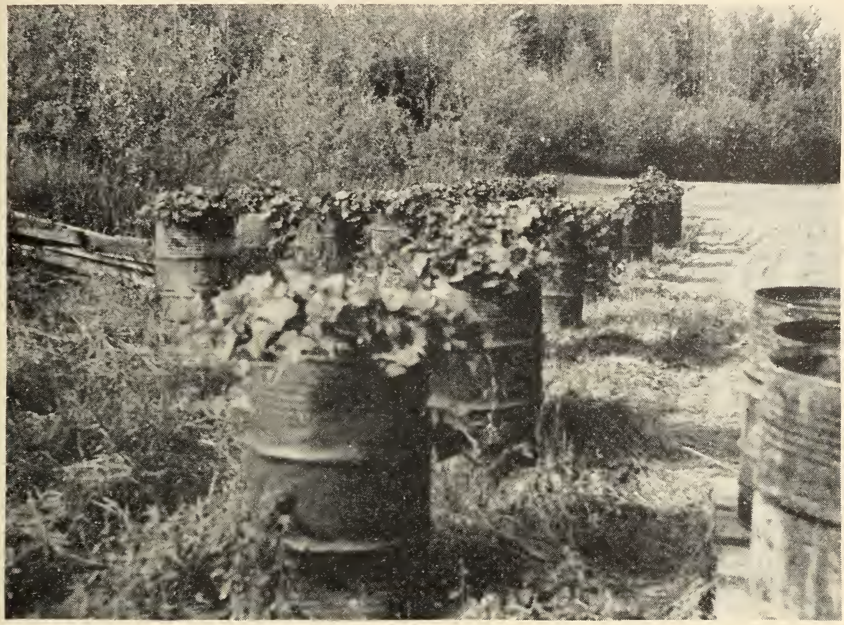

FIGURE 85.—Cucumbers growing in oil drums filled with composted soil, July 10, 1946. The drums absorb the heat, and the soil inside warms up earlier.

Other problems.—The main problem was to find varieties that would grow and mature fruit under the conditions of long days, short growing season, and low heat units.

OTHER WARM-SEASON VEGETABLES

Warm-season vegetables other than the vine crops, including corn, eggplant, okra, and pepper, are not commonly grown out of doors in most sections of Alaska. By starting the plants of early-maturing varieties in the greenhouse it has been possible in warm summers to grow small amounts of green peppers, eggplants, and sweet corn, but the results are too uncertain to warrant commercial production.

SMALL FRUITS AND BERRIES

NATIVE OR WILD KINDS

Most sections of Alaska have one or more kinds of wild berries or bush fruits that can be used as fresh fruit, or preserved as jellies, jams, preserves, or juice for beverage purposes. The most common kinds are red raspberries, blueberries, lowbush cranberries, highbush cranberries, strawberries, black and red currants, gooseberries, salmonberries, and juneberries. Also available as human food but usually in smaller amounts or of more limited usefulness are rose hips, cloudberries, crowberries, bunchberries, billberries or whortleberries, red elderberries, red bearberries, alpine bearberries, and honeysuckle bearberries.

The wild red raspberry is very abundant in the Tanana and Matanuska Valleys and in the Homer area, and in size and flavor it compares favorably with cultivated varieties. The berry is somewhat smaller than the Cuthbert variety, but the flavor is stronger and slightly more acid. The plants respond with increased crops when put under cultivation, but the woods provide ample supplies for anyone wishing to pick them.

Blueberries are so abundant in numerous locations that more than a gallon an hour can be picked. The berries are one-fourth to three-eighths of an inch in diameter, dark blue to black in color, and make better tasting pies than most cultivated varieties in the States because they are more acid. The quantities available warrant a freezing or canning industry if help could be obtained for picking.

The wild lowbush cranberry of Alaska is round and much smaller than the varieties commonly cultivated in the States, but it has more color and a more acid flavor. It contains sufficient acid to keep well without heating or cooking and may be preserved over winter by merely packing in cold water in jars or crocks. The highbush cranberry is also very abundant in certain sections, and although because of its large, flat seeds it is not as suitable for pie or sauce as the lowbush cranberry, it is very useful in making jellies, jams, and beverages, and it is much easier to pick since the plants are 3 to 5 feet high.

Although wild strawberries are of very fine flavor they are undesirably small. Cultivated varieties are much easier to harvest and are well enough adapted. Because of their small size, the wild strawberries are less popular than several other wild berries.

Salmonberries are very abundant on Kodiak Island and in southeastern Alaska, and the plants make large clumps or thickets that are prominent features of the landscape. The fruits are large and too soft to ship, but they are of excellent quality as a dessert fruit and useful for making jams, preserves, jellies, or juice.

Currants are abundant in the woods in the Tanana and Matanuska Valleys and the red fruits are in great demand for jelly making. The berry compares favorably in size with some of the cultivated varieties.

CULTIVATED VARIETIES

Almost every garden in Alaska has a small area in strawberries. The variety is usually Sitka Hybrid except in the Tanana Valley, where the Badger berry is the most common. A study of the Sitka Hybrid strawberries now grown in the Territory reveals that there are three or more distinct types of fruit under this name. This probably means that the numbers attached to the varieties of strawberries sent out for trial by the Sitka Experiment Station early in this century have been lost or forgotten in the intervening years. Plants of the surviving kinds or varieties have been passed from neighbor to neighbor and all are known as Sitka Hybrid. They differ slightly in size, shape, flesh color, and flavor, but all are winter hardy and productive.

The variety known locally in the Tanana Valley as the Badger berry is the John Scharle variety, according to H. M. Badger, who is largely responsible for its popularity (fig. 86). Mr. Scharle is reported to have selected the variety from a cross made about 1910 between the wild berry of the Tanana Valley (*Fragaria platypetala*) and an unknown variety imported from the United States. It is probably the hardiest variety in this locality with its low temperatures, and it makes a very large number of runners. The medium-sized, ovate-shaped, purplish-red berries are very numerous and of subacid, or sweet, flavor with a delightful aroma.

Most of the strawberry varieties from commercial producing areas of the United States fail to survive the first winter in the Tanana and Matanuska Valleys. Recent introductions from the northern Great Plains States and Canadian Provinces show some promise of succeeding in Alaska. The Atkinson, Bennet, and Family Style varieties, deeper red in color and more acid in flavor than the John Scharle or Badger variety, survived at least one winter. In southeastern Alaska where the winters are not as severe, a large number of varieties of strawberries may be grown successfully. Rockhill ever-

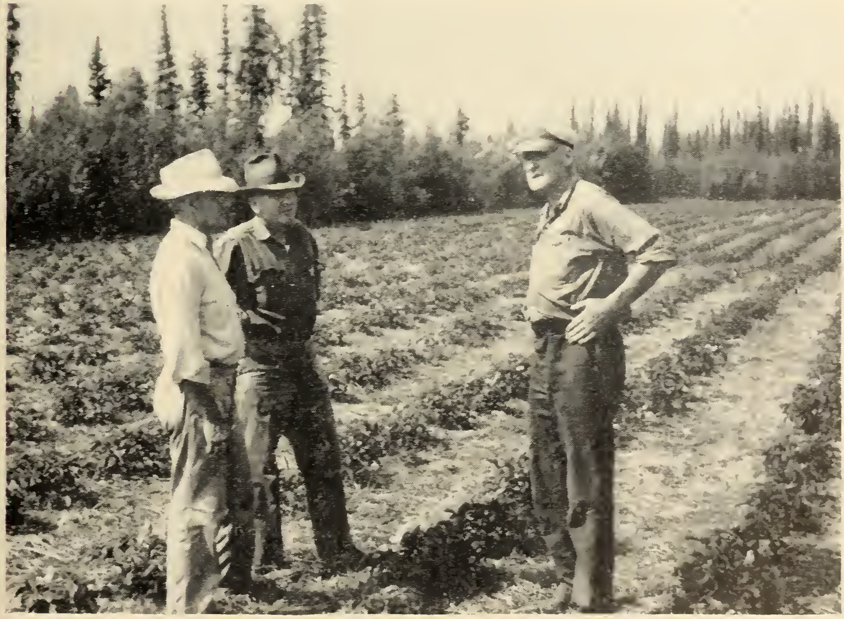

FIGURE 86.—H. M. Badger (right), the "Strawberry King" of Alaska, discussing his 4½ acres of John Scharle strawberries in the Tanana Valley with U. S. Department of Agriculture specialists. Note the character of the native vegetation.

bearing strawberries were growing and fruiting well at Wrangell in 1946.

Most gardeners did not know the variety of red raspberries they were growing, but the one most commonly named was Cuthbert (fig. 87). Chief and Sunbeam were only partially hardy in the Tanana Valley and seemed to have no advantages over Cuthbert.

None of the cultivated varieties of blackberries introduced into the Tanana and Matanuska Valleys survived, and it is only in southeastern Alaska that one finds blackberries of several different kinds or varieties.

Cultivated varieties of gooseberries winterkill badly in the northern and central sections of Alaska but do well in the southeastern section.

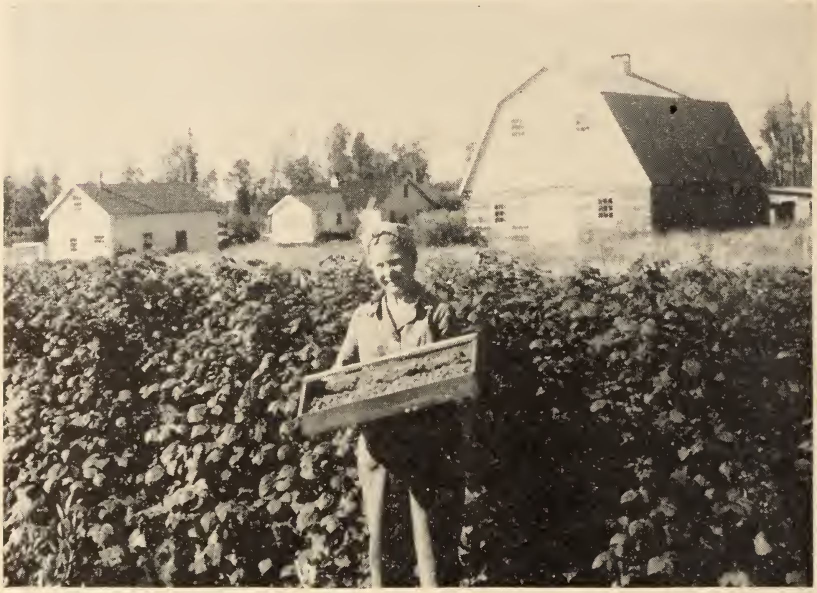

Figure 87.—Mrs. A. C. Benner of Palmer, Alaska, with a tray of 8 pints of Cuthbert red raspberries from her 2½ acres of this popular bush fruit. The buildings in the background are typical of the farmsteads provided by the Government for the group of settlers brought in in 1935.

Cultivated varieties of white and red currants are common in gardens throughout Alaska.

None of the improved or named varieties of blueberries common in the States have proved hardy in the northern and central sections of Alaska.

COMMERCIAL POSSIBILITIES

The largest field of strawberries seen was 4½ acres in the Tanana Valley and the largest planting of red raspberries was about 2½ acres in the Matanuska Valley. A great many home gardens contained both strawberries and raspberries, and surplus production from these garden patches supplied part of the market demand. The markets at Fairbanks and Anchorage as well as some of the smaller towns in southeastern Alaska were not able to obtain enough berries or other small fruits to supply the demand, even though there was an abundance of wild berries to be had for the picking. Prices of 40 to 60 cents a pint in wholesale quantities should be sufficient incentive for greater production of strawberries and red raspberries. Under good cultural conditions the yields of both kinds are very good and the ease of harvesting the cultivated crop is a great advantage in competing with the wild berries. The present markets would seem to warrant small acreages of cultivated berries adjacent to the smaller towns and larger acreages near the larger markets. Should facilities be installed for freezing, preserving, and canning the small or bush fruits, the commercial acreage would need to be greatly increased to meet the local demand. Because of the availability of land, the most likely places for this increase would be in the Tanana and Matanuska Valleys.

Trial plantings of selected plants of the wild blueberry in the Tanana Valley indicated that blueberries might be a profitable cultivated crop for the fresh market and for processing.

The lowbush cranberry thrives in most sections of Alaska, and there is a possibility that the large, cultivated varieties might be successfully grown on a commercial scale in southeastern Alaska.

TREE FRUITS

Numerous experiments in central and northern Alaska show that the winters are too severe in the interior for the survival of most kinds of tree fruits. Many of the hardy varieties from the northern Great Plains and Canada have failed to produce mature fruit even though some of the trees survive for a few years. The Norwegian cherry or chokecherry is the only consistently bearing fruit tree in the Tanana Valley unless the serviceberry or juneberry is considered a tree fruit.

There are a few bearing apple trees of an unknown Russian variety in the town of Anchorage. In southeastern Alaska there are a number of specimens of fruit trees of different kinds and varieties, but because of the poor soil and excessive rainfall the production is scanty and of poor quality. At the old experiment station at Sitka (fig. 88) are bearing trees of apple, pear, sweet cherry, and sour cherry, and on other islands in southeastern Alaska the list can be enlarged by quince and plum. In all cases seen the number of trees involved was very small, although a newly planted orchard of small size was reported at Haines.

FLOWERS, SHRUBS, AND TREES

A wealth of flowers and shrubs, both native and introduced, beautify Alaska homes (fig. 89). The size and the bright color of many of the flowers grown in the cool, long days under sub-Arctic conditions are impressive. From the excellent flowers seen everywhere, it is evident that Alaska has a large number of good gardeners and many flower lovers. One can see more kinds of flowers in bloom at one time during the short season in central and northern Alaska than in the central United States.

Almost all the cool-season annuals grow very well in Alaska. Especially fine growth and bloom was noted in snapdragon, candytuft, annual chrysanthemum, calendula, California poppy, Unwin dahlia, forget-me-not, godetia, lobelia, marigold, mignonette, nasturtium, memophila, petunia, Shirley poppy, schizanthus, stock, and sweet pea.

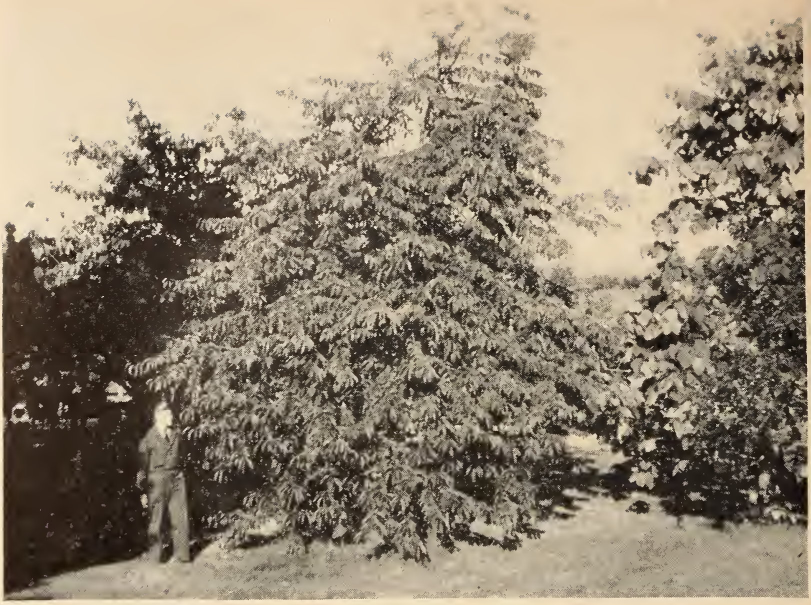

FIGURE 88.—Sweet cherry trees on the grounds of the old experiment station at Sitka, Alaska.

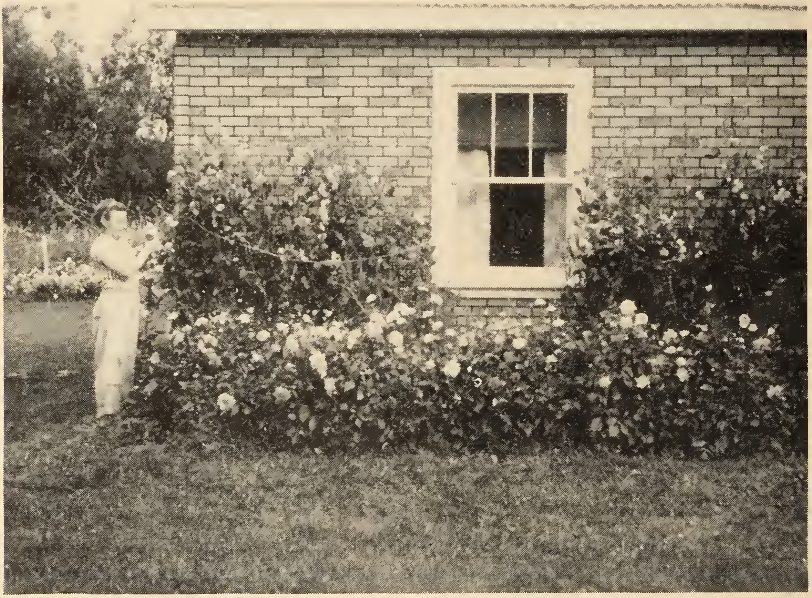

FIGURE 89.—Unwin Hybrid dahlias (in front) and 7-foot sweet peas against the house of Mrs. Max Sherrod, Palmer, Alaska.

The quality of the blooms was equal to that of greenhouse-grown specimens in many cases.

Biennials and perennials that prefer cool weather also grow to perfection in many parts of the Territory. Delphinium, pansy, and pink are especially outstanding, but columbine, campanula, hemerocallis, foxglove, lupine, phlox, Shasta daisy, sweet-william, and viola were also apparently well adapted to the Tanana Valley and sections south of it.

It is reported that most of the small spring flowering bulbs such as crocus, grape hyacinth, snowdrops, and scilla, and the larger bulbs of hyacinth, tulip, and narcissus all flower well, are long-lived, and are easily propagated. Nonhardy roots, corms, and tubers of dahlias, gladiolus, peonies, lilies, and tuberous-rooted begonias produce marvelous flowers under good cultural conditions. Preliminary experiments at the Sitka Experiment Station indicate that commercial production of bulbs of narcissus and tulips may be possible in certain locations in southeastern Alaska.

In the interior valleys, the number of kinds of flowering shrubs and small trees that will survive the winters is smaller than farther south, but at Fairbanks it has been possible to maintain and to flower several *Rosa rugosa* varieties and hybrids, including George Wills, Rugosa Red, Rugosa White, Hansa, Amelie Gravereaux, and Betty Bland. Hybrid tea and hybrid perpetual roses winterkill at Fairbanks and Anchorage. The wild rose (*Rosa acicularis*) is very attractive both in flower and fruit. The fruit is Chinese scarlet in color, decorative, and usually very abundant. Another attractive red-berried wild shrub quite common in damp locations is the red-berried elderberry (*Sambucus callicarpa*). While most of the French hybrid lilacs tried to date have winterkilled at Fairbanks, the Pocahontas, Hiawatha, Assessippi, and Minnehaha of the named varieties have flowered well. A number of the Sitka Hybrid roses are seen in central Alaska as well as in the southeastern section. The Siberian pea tree is hardy at Fairbanks, can be trimmed to any shape, and makes a wonderful hedge (fig. 90). Tatarian or bush honeysuckle, Lorbergii pea tree, Siberian flowering almond, Skinners azalea, Korean spirea, *Daphne mezereum*, and the May Day tree are other imported shrubs or small trees of proved hardiness and ornamental value in the Tanana Valley and southward.

Sufficient native or indigenous plant material is available in the interior valleys to provide excellent landscaping materials for almost any type of planting desired. The list of trees includes white spruce. black spruce, lodgepole pine, white birch, Kenai birch, larch, poplar, cottonwood, and aspen; small trees and large shrubs are Sitka alder, red alder, mountain ash, and many kinds of willows. Medium and small shrubs are ground birch, blueberry, juniper, serviceberry, highbush cranberry, dogwood, silverberry, leather leaf, Labrador tea, *Spirea steveni*, buffaloberry, and cinquefoil. Ground cover and rock garden plants are bearberry, twinflower, crowberry, bog rosemary, bunchberry, moss heather, baneberry, dogbane, iris, goatsbeard, columbine, monkshood, larkspur, bedstraw, Jacob's-ladder, white mountain avens, violet, forget-me-not, anemone bluebell, lupine, monkeyflower, and shootingstar.

The rock gardens of southeastern Alaska were especially fine (fig. 91). They contained a wide range of plants of very much the same

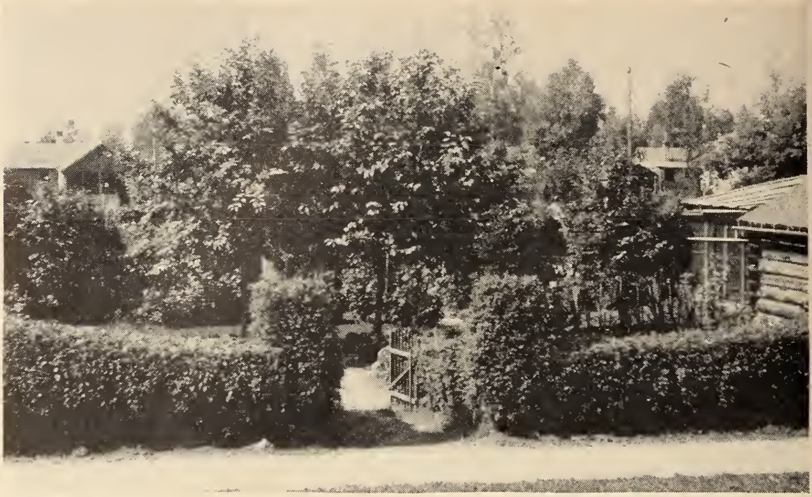

Figure 90.—The always-open garden gate of the Enos VanRae home in Fairbanks. Note the fine hedge of Siberian pea tree and the two trees of Norwegian cherry.

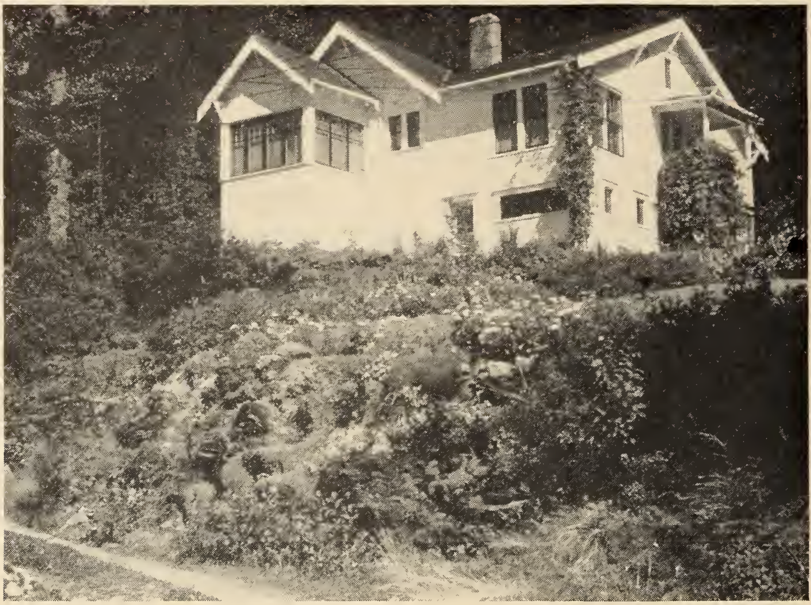

Figure 91.—Modern home and fine rock garden in a natural location, north end of Wrangell.

kinds found in the gardens of Vancouver Island and the Puget Sound section of Washington State.

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Report on Exploratory Investigations of Agricultural Problems of Alaska

Chapter 5. Livestock Problems in Alaska

LIVESTOCK PRODUCTION

By N. R. Ellis, *in charge of Animal Nutrition Investigations, Animal Husbandry Division, Bureau of Animal Industry*

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The need for increased production of livestock and livestock products in Alaska is probably best illustrated by the fact that only 15 percent of the total food requirements of the population were supplied from Alaskan farms in 1946. Since production of vegetables, especially of potatoes, has forged ahead of that of livestock, it is a safe conclusion that Territorial livestock production met less than 15 percent of the needs.

This failure to increase the production of meat, milk, and eggs even to parallel that of vegetables may be taken by some students of Alaskan agriculture as evidence that these animal products should continue to be imported. It may be argued that difficulties and expenses in connection with the production of concentrate feeds and of winter feed generally, on the one hand, and improved facilities for transportation of animal food products, on the other, favor dependence on outside sources of supply.

There is every reason to believe, however, that farming is sure to continue to expand as a basic industry and that livestock must play a greater part in farming operations if a more balanced and stable agriculture is to be established in Alaska, as is possible. The raising of livestock provides an outlet for various crop residues and byproducts. Livestock provide the means of utilizing the grassland crops and of further diversifying the farm operations, and they return fertilizing elements to the soil in the form of manure. Furthermore, livestock raising is usually a permanent type of agriculture that adds stability to a community.

Expanded livestock production can add much to the health and welfare of the people of Alaska. Perishable foods of high nutritive value, such as fluid milk and eggs, which are difficult to transport, are denied to too many Alaskans, to the detriment of their health and well-being. The influx of new people, including Army and Navy personnel and others used to high living standards and educated to the value of protective foods, has increased and will continue to increase the demand for milk, eggs, and fresh meats. The desire for self-sufficiency, added to the newer knowledge of the necessity for protective foods in the diet, creates urgent demands on the part of farmers for information on how to produce livestock under Alaskan conditions.

HISTORY OF LIVESTOCK RAISING IN ALASKA

Livestock farming in Alaska is by no means a new venture, though a trip through the Alaskan countryside reveals surprisingly little of past efforts to raise livestock. Indeed one gains the impression, in the Tanana and Matanuska Valleys especially, that dairying and poultry raising are relatively new enterprises, that beef-cattle and sheep raising are only beginning, and that Alaskans lack the experience to determine the adaptability of livestock to the environment.

The records show, however, that the Russians introduced most of our classes of farm livestock at an early date. Most of the Russian settlements had a few cattle, some chickens, and even hogs. They were generally well distributed, a few to a family. When the Office of Experiment Stations made a survey in 1898, preliminary to the establishment of the first experiment station, the investigators saw some of the descendants of the Russian cattle. At Ninilchik village on the Kenai Peninsula, for example, there were about 30 of these small, inbred cattle. American settlers along the southern and south eastern coast often possessed a few cows, some goats, or some poultry. Horses were used as pack animals and for work around the mines. The missionaries often brought in livestock, especially milk cows, and some of them made ensilage from beach grasses and the native bluetop instead of trying to dry hay in the humid, wet climate of the coastal settlements. Small dairy herds of Juneau, Ketchikan, Wrangell, and other settlements supplied milk to the inhabitants. About 1900, transportation facilities were especially poor, and the products had to be used within the immediate area. Costs of production were high, just as now, and the demand for milk, for example, was limited in the small settlements. Difficulties of providing winter feed were fully recognized.

In the interior of the Territory, livestock numbers were especially limited. Even after the establishment of farms around gold-mining towns such as Fairbanks, few farmers kept livestock other than horses. Attention turned instead to the raising of vegetables, grain crops, and small fruits. Some movement of livestock to the interior did take place, however. Cattle were shipped in by boat to Valdez and Skagway in the spring and then driven overland or reloaded on river boats to be taken to mining centers, where they were pastured during the summer and slaughtered at intervals to supply meat. Residents of Fairbanks also tell of boatloads of cattle brought down the Yukon in the spring after overland movement across Canada. At Fairbanks there are still evidences of abandoned grazing grounds where these herds were held for the summer. By the time of World War I, this practice was discontinued, however. In those early days, large numbers of horses were kept for transporting supplies to mining camps. Feed had to be provided, some of which was produced locally while the rest was shipped in by boat and wagon.

The Alaska Commercial Company and some other organizations, even before 1900, had placed fair-sized herds of beef cattle, goats, and sheep on islands in the vicinity of Kodiak. The efforts were not especially successful, but the failures were largely due to lack of care rather than lack of feed. At the time the Office of Experiment Stations made the early surveys, the general opinion appeared to be that the raising of beef cattle was not profitable and was on the decline. The need for more hardy types of both cattle and sheep was also expressed.

It was not until 1906 that the Department introduced any experimental herds or flocks at the experiment stations then established, although a small beginning had been made at Kenai with a few native milk cows. The introduction consisted of the nucleus of a herd of Galloway cattle, part being placed at the Kenai Station and part on Wood Island near Kodiak. Further additions followed the next year. Subsequently the entire herd was moved to Kodiak Island. The reasons for undertaking work with the Galloway breed were mainly to test the hardiness of the breed and the ability of the animals to utilize the native forages growing on the range lands of the hills and beaches of the coastal areas. It was recognized that both dairy products and beef were needed to supply the local needs, and efforts were consequently made to develop the Galloway herd in the direction of a dual-purpose type. This attempt was eventually abandoned.

The next step was the crossing of Galloways with Holsteins. Milking Shorthorns were brought to the Matanuska Station in 1920. Then in 1925, a small Holstein herd and the Galloway-Holstein stock were moved from Kodiak to Mantanuska. Comparison of the three groups was carried on for several years until the Shorthorns were disposed of, presumably because they appeared to be the least hardy. After the transfer of the experiment stations to the Territorial government in 1932, the work with Galloways and Galloway-Holsteins and some experiments with Galloway-yaks were discontinued. There is little visible evidence today of the effects of these studies on the cattle population of Alaska except in one or two herds on islands in the Kodiak area.

The successful propagation of the herds by the experiment stations, however, undoubtedly did much to establish confidence among farmers that cattle raising was feasible. In more recent years, other breeds such are Hereford, Aberdeen Angus, Guernsey, and Ayrshire have been introduced and along with Holsteins now form, either as grades or purebreds, the predominating cattle population. Some of the older notions about ruggedness and ability to rustle for feed seem to have been dissipated.

During the past 50 years, numerous individuals and organizations have brought in bands of sheep. There are many failures, largely due to inadequate management, but there are also instances of success. The larger flocks have been and are still to be found on islands in the Kodiak area and the Alaskan Peninsula. The Matanuska Station has maintained a small flock since 1920, largely of grade Cotswolds, although Lincoln rams were used also. In recent years, a change has been made to sheep of the Hampshire breed.

Fur farming was a much more important enterprise in former years than at present. The raising of blue foxes on small islands along the southern coast of Alaska was especially noteworthy. Though not pen raised, these foxes required considerable attention, and their production was classed as distinct from the trapping of wild foxes. Fox and mink farms were operated on the mainland also. Because of the great advances in fur farming in the States in recent years, not only in numbers of pelts but in new strains and mutations, the Alaskan industry suffered severely. The Alaskan fur farmers were unable to keep up with the changes in market demands brought about by these developments, and the severe decrease in prices drove many out of business. World War II caused others to close out their operations.

Many farmers visited during the summer of 1946 were once engaged in fur farming, but few manifested much interest in resuming it, having turned to other agricultural pursuits. Most of these farmers were located on the mainland, where supplies of locally produced fox and mink feed were limited and expensive.

PRESENT STATUS OF LIVESTOCK PRODUCTION

The most recent census figures, those for 1939, some of which are given in table 1, show comparatively small numbers of livestock in Alaska. Though there was undoubtedly some change, probably an increase, in the livestock population in the interval between 1939 and 1946, these figures indicate the insufficiency of animal products and the consequent field for expansion. For example, egg production according to the census was 97,450 dozen, or approximately 14 eggs per individual per year on the basis of a population of 80,000 persons. On a similar basis the milk products provided 24 quarts per person.

The distribution of livestock by areas is of special interest. The census figures are given in table 1 according to judicial districts. The first comprises the southeastern or Panhandle area, in which are located the cities of Juneau, Ketchikan, and Petersburg. The numbers of milk cows, goats, and chickens represent relatively large percentages of the total for the Territory and undoubtedly reflect the greater ease of shipment and lower costs of imported feeds. The second district, in the northwestern part of the Territory, includes Nome. This area is very thinly populated and agricultural resources are exceedingly limited.

Table 1.—*Numbers of livestock in Alaska according to 1939 census*

	First district (southeastern)	Second district (northwestern)	Third district (southern)	Fourth district (central)	Entire territory
	Number	*Number*	*Number*	*Number*	*Number*
Horses and mules	27	11	70	53	161
Milk cows	445	--------	657	115	1, 217
All cattle	674	--------	3, 040	175	3, 889
Swine	45	--------	812	165	1, 022
Sheep and lambs	33	--------	17, 043	--------	17, 076
Goats	243	--------	164	27	434
Chickens	6, 808	102	16, 734	404	24, 048
Turkeys	--------	--------	638	--------	638
Ducks	24	--------	58	--------	82
Geese	37	--------	330	--------	367

The third judicial district has the greatest concentration of livestock of the four districts. The area comprises all the southern portion exclusive of the Panhandle. Within this district is the Matanuska Valley and the adjoining city of Anchorage, the Kenai Peninsula, Kodiak and other islands, and the Alaska Peninsula. Most of the milk cows are to be found in the Matanuska Valley. Beef cattle comprise a large percentage of the cattle in the third district, and most of them are presumed to be found on Kodiak, Sitkalidak, and other islands and on the Kenai Peninsula. The main concentration of sheep and lambs is to be found on the islands, including those of the Alaska Peninsula. Poultry are concentrated in the Matanuska Valley, although some are to be found at Homer and presumably other settlements of the Kenai Peninsula.

It is surprising to find that livestock numbers are so limited in the central district, in which the Tanana Valley lies. The 1946 survey attests to the small numbers of cattle, sheep, and goats found there. A considerable percentage increase in swine and poultry has taken place, but the total numbers are still small.

Many of the early gold miners who have stayed on in Alaska have taken up farming. Some have turned to livestock, especially in the Tanana Valley. A few have made a real success by seeing their opportunities and applying themselves to their jobs. Some others who started later have also succeeded.

Colonization enterprises such as that in the Matanuska Valley brought in groups of farm families with varying potentials for success. In the main they came with little capital but were given considerable government aid. After more than 10 years their ranks have been weeded out for one reason or another, with new families coming in to take the place of those departing. The farm population is still relatively new and very much of the pioneer type. Compared with farmers in long-developed communities in the States, those now in the Matanuska and Tanana Valleys measure up fairly well, on the whole, in ability. It is the newcomers, by and large, who are most interested in scientific assistance and most likely to have plans for expanding their livestock production.

Meat was the livestock product in demand in the early days, and this prompted the importation of beef animals. Today the main emphasis is on dairying to supply fluid milk and poultry raising to supply eggs. Matanuska livestock farmers are producing these two products almost to the exclusion of meat except when they slaughter veal calves and discarded milk cows. Beef, pork, butter, cheese, and related products shipped from the States have appeared to render local competition difficult. According to the present outlook, production methods must be such as will make unnecessary the extensive use of cleared land for grazing, the growing of forage for 8 or 9 months of winter feeding in the barn, and production of concentrate feeds for supplementing the forages.

Most of the hogs raised are fed garbage obtained from the population centers. This practice was stimulated during the war by encouragement from the Army. Thus the five or six farmers around Anchorage and Fairbanks who feed garbage exclusively market approximately 1,100 hogs annually. This is a large number for these areas alone when compared with the 1939 census figure of 1,022 head for the Territory.

As already indicated the most progressive although still greatly underdeveloped community is the Matanuska Valley centering around the town of Palmer. The livestock products in order of importance are fluid milk and eggs, meat from dairy stock, poultry meat, pork, wool, and lamb and mutton. In the Tanana Valley, fluid milk produced by two large dairy farms and the Experiment Station stands out, with pork from a few garbage feeders and eggs from numerous small flocks of next importance. The production of beef and veal, poultry meat, wool, lamb, and mutton is relatively small. In the Homer area there are relatively more beef cattle and fewer dairy cattle. The meat is consumed locally and certainly does not supply a very large amount per capita. A few new poultry flocks are being started. In time there can be enough poultry to meet the local needs and supply some for shipment to Anchorage and Kodiak. Some butter is sold by farmers living in remote areas. One large dairy is near the Naval Base on Kodiak Island, and there are several around Juneau. The main beef-cattle herds are on Kodiak Island in addition to those already mentioned on Sitkalidak and Chirakof Islands. The flocks of sheep are concentrated apparently on Sitkalidak, Unalaska, and Umnak Islands.

The survey of fur-farming activities in 1946 revealed a greatly curtailed scale of operations as compared with that of prewar years. This was true not only of island-operated fox ranches but of pen-raised mink and fox production on the mainland. Many farmers moved away or engaged in other work at military bases. The drop in prices of furs and the curtailment of feed supplies were primary factors in the closing out of many of the operations. Meat supplies from wild game or otherwise have disappeared or become too expensive. Visits made in 1946 to a dozen towns along the coast from Petersburg to Nome revealed only a few fur farmers still in business of the many who operated before the war. Several island farmers in the vicinity of Kodiak still raise foxes. The few mink ranches are widely scattered as are also the remaining fox ranches. Several ranches are in operation in southeastern Alaska in the vicinity of Petersburg and Ketchikan. The general impression is that part of the present low state of the industry is due to the mediocre quality of so much of the breeding stock. The furs produced are not of the type or quality to bring the highest prices on the market.

The experimental fur farm operated at Petersburg by the Alaska Experiment Station in cooperation with the Department's Bureau of Animal Industry has colonies of foxes, mink, and marten. Emphasis is placed on the use of waste fish and fish waste from the canneries in the diet. As with privately operated ranches, a considerable portion of the feed is in the form of cereal and related products imported from the States.

Progress is being made in finding feed mixtures which use a maximum of locally produced fishery products and in studying the feeding problems involved. The large number of inquiries from fur farmers and others about breeding, feeding, and management indicate the interest in this activity and the need for more information applicable to fur farming under Alaskan conditions.

The centers of livestock population and the type of product marketed are in large measure the result of experience over many years. The local conditions, including grazing land, the crops which can be grown, climate, transportation, and markets, have made the present situation what it is for the most part. More roads, liberal financing plans for land clearing and other farm improvements, cheaper labor, changes in the Territorial taxation system, and many other factors not strictly agricultural can change the picture considerably in a few years. Not to be overlooked, also, are the new generations of farmers who will come and may succeed where their predecessors have failed.

THE FEED SUPPLY PROBLEM

Providing adequate diversified feeds is a problem which has impeded the expansion of livestock production from its very beginning. Viewed from the long-time standpoint the development of sources of supplies of tame forages and of concentrates has lagged. Soil and climatic factors plus high costs of clearing the land have combined to make it extremely difficult to introduce and develop types and species of the plants common to the Temperate Zone on any extensive scale.

Most of the concentrate feeds continue to be imported just as they have been for upwards of 50 years. Dairy herds in many instances are fed on hay imported from the States of the Pacific Northwest. Even fish meal produced by canneries along the southern coast and the islands adjacent to the Alaska Peninsula and the Southeast is first shipped to ports of Washington and Oregon and then reshipped to points in Alaska. Mixed concentrate feeds for cattle and poultry are imported for the most part.

These circumstances persist even though the Alaska countryside shows an abundant growth of native grasses during the summer. The native bluetop has been utilized extensively through the years. Experience seems to have shown that this grass cannot stand continuous heavy use, particularly when cut annually. After 2 or 3 years of cutting the yields decline and the area must be rested to permit recovery. The problem, however, is not entirely one of continuity of supply. Utilization and management practices seemingly have not changed with respect to the preservation of the grass as hay or silage, to say nothing of summer grazing management. A few yields of tame or introduced forages have proved the ability of these crops to survive and produce good yields. Examples are bromegrass and alsike clover, fields of which in the Tanana Valley near Fairbanks and in the Matanuska Valley showed excellent growth in the summer of 1946. In some cases the stands have held up for a considerable number of years. Efforts to grow alfalfa have not met with sufficient success to encourage its general use on farms. Experimental plots of Siberian alfalfa, a yellow-blossom type, show excellent growth, but reports indicate that seed development is uncertain. Thus its propagation from locally grown seed has been very limited.

Main dependence for tame forages is placed on small grains such as oats and barley with an admixture of field peas and vetch. A relatively large acreage is planted annually and harvested as hay or silage. Harvesting the crop as hay is usually difficult. The late summer rains and the cool weather necessitate extended drying periods for field curing. The quality undoubtedly deteriorates in proportion to the unseasonableness of the weather.

Raising small grains as a source of concentrate feeds has evidently proved too expensive in comparison with importation of grains and mixed concentrates. In former years considerably more wheat and other cereals were grown and harvested for grain in the Tanana Valley than at present. A flour mill was once operated in Fairbanks, for example. A threshing machine, unused for a number of years, was seen on one of the larger farms. For the most part, farmers have had to depend on varieties of grains developed in the States which were the best available for Alaskan conditions. Further efforts to develop early-ripening strains well adapted to the soil and climate seem to be indicated. The relatively small acreage of cleared and cultivated land, even in the older settlements of the Tanana and Matanuska Valleys, combined with the comparatively greater returns from growing potatoes and other vegetables, probably accounts for the present small acreage of wheat, oats, rye, and barley grown for grain. Costs of land clearing and of farm labor generally have also worked against increases in or even maintenance of acreage in these crops in the face of generally low yields and the uncertainty of proper ripening of the grain.

There is a prevailing idea that the native grasses lack the feed value possessed by tame forages. In part, at least, this idea is correct in that the rapid rate of growth during early summer has not been met by corresponding early harvesting. Furthermore, the curing of hay is often poorly done. Too often the native hays are cut late, when they have become woody, and are cured in small cocks on wooden supports exposed to the sun and rain.

Analyses made on samples taken during the inspection trip, principally in July, lend considerable support to the contention that the feed value of the forages is low and variable. Some figures are given in table 2 for samples of bluetop collected at various places. It will be noted that there is a wide range in protein content for samples obtained from different areas. The contrast between the low values of samples obtained near Fairbanks and Standard and the high values of samples from the Circle Hot Springs and Lignite areas are probably a reflection of stage of maturity, even though the samples were taken at about the same time. In other words, the rate of development varies with the area and its particular climatic conditions. The phosphorus content of the material collected at Fairbanks and Standard, and possibly at some other locations, while not showing any very extreme values does indicate border-line or probably inadequate levels to meet minimum requirements for cattle and sheep.

Table 2.—*Variations in composition of bluetop* (Calamagrostis canadensis) *shown in samples collected in different areas of Alaska*[1]

Location	Date of collection	Crude protein	Crude fiber	Calcium	Phosphorus
		Percent	*Percent*	*Percent*	*Percent*
Circle Hot Springs	July 15, 1946	8. 69	29. 88	0. 57	0. 24
Do	do	11. 36	30. 07	. 46	. 19
Fairbanks	July 11, 1946	4. 23	37. 81	. 19	. 13
Standard	July 18, 1946	4. 80	35. 22	. 12	. 12
Lignite	do	13. 16	30. 69	. 34	. 17
McKinley Park	July 19, 1946	9. 80	31. 57	. 27	. 15
Hurricane	July 20, 1946	8. 53	31. 72	. 13	. 15
Curry	July 21, 1946	8. 10	35. 91	. 22	. 22
Homer lowland	July 30, 1946	7. 82	37. 25	. 12	. 18
Homer upland	do	7. 61	38. 55	. 15	. 18
Kodiak	August 3, 1946	10. 34	36. 75	. 13	. 20

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[1] Selected constituents expressed on moisture-free basis.

The calcium values are the most remarkable, however, in showing variations, since grasses in the States seldom have deficiencies in this element. Values under 0.2 percent are ordinarily considered inadequate, and in this category must be placed the samples from Fairbanks, Standard, Hurricane, Homer, and Kodiak. The bluetop growing at Circle appears to be the highest in calcium, and it also ranks in the higher brackets for phosphorus and protein.

Data are given in table 3 for a number of other samples of native and tame forages in both mixed and pure stands. The protein values are not unlike those of forages in the States. Of interest are comparisons of bluegrass and oats, designated as good and poor, collected at Palmer. These pairs were taken in the same fields, from areas of good growth with deep-green coloration and of poor growth with pale-green coloration. The extent to which the protein content differs between the pairs appears to reflect some abnormal soil characteristics which merits further investigation.

Table 3.—*Composition of miscellaneous forage samples collected in different areas of Alaska* [1]

Material	Location	Crude protein	Crude fiber	Calcium	Phosphorus
		Percent	*Percent*	*Percent*	*Percent*
Sedge-bluetop	McKinley Park	12. 37	28. 64	0. 31	0. 15
Sedge	Wasilla tide flat	9. 85	25. 10	. 22	. 20
Sedge-mixed grasses	Cold Bay	7. 77	33. 13	. 14	. 18
Beach grass-peas	Seward	11. 55	33. 04	. 13	. 24
Beach wild-rye	Kodiak	8. 77	40. 85	. 13	. 18
Do	Nunivak	14. 95	27. 96	. 16	. 29
Mixed grasses	Amchitka	9. 92	28. 30	. 13	. 24
Do	Shemya	15. 44	24. 74	. 19	. 33
Do	Dutch Harbor	11. 45	27. 06	. 21	. 16
Do	Umnak	10. 47	27. 51	. 23	. 24
Do	Sitkalidak	7. 65	30. 58	. 17	. 14
Do	Nunivak	7. 60	26. 01	. 19	. 14
Do	Bethel	6. 97	28. 15	. 24	. 11
Tame grasses (brome)	Fairbanks	9. 21	29. 11	. 52	. 15
Quackgrass, etc	Circle	6. 00	31. 82	. 33	. 09
Do	do	5. 10	30. 11	. 28	. 12
Do	Tonsina Lodge	6. 18	27. 20	. 32	. 09
Bluegrass, dark green	Palmer	19. 44	23. 81	. 47	. 21
Bluegrass, light green	do	9. 69	24. 78	. 37	. 21
Green oats, good	do	11. 85	31. 65	. 27	. 23
Green oats, poor	do	7. 14	29. 55	. 18	. 39
Oat hay	Fairbanks	11. 04	35. 19	. 22	. 17
Oat-pea silage	do	9. 88	32. 22	. 34	. 29
Alfalfa	Palmer	18. 76	31. 05	1. 79	. 25

[1] Selected constituents expressed on moisture-free basis.

The generally low calcium values of the forages collected on the various islands of southwestern Alaska are of greatest concern. Unless the content increases to higher levels during the fall and winter, it would appear that deficiency symptoms in bone growth might well develop in livestock living on these forages. Such symptoms were not evident, however, in cattle and horses seen on the islands during our visits. It is true, of course, that cattle become rather emaciated during the late winter on Kodiak Island, for example, and a supplement of bonemeal or some other source of calcium, as well as of phosphorus, appears desirable.

More analytical studies on material collected on a yearlong or entire growing season basis are certainly indicated by the work just discussed. A limited number of chemical studies of grasses have been published, but in the main the requests for establishment of chemical and nutritional laboratories for study of both animal and human foods are well founded. While evidence of striking deficiencies were not encountered to any great extent during the inspection trip, there is good reason to believe that there are various important problems. Cases of rickets in calves and sheep were seen, and the better informed farmers know that fish-liver oils are effective preventives. With forages sometimes deficient in calcium and phosphorus, the vitamin D problem becomes especially important. No evidence of vitamin A deficiency was obtained, and certainly during the summer there is little reason to suspect it. The hay-curing methods, however, probably result in excessive losses of carotene. The whole field of vitamin content and preservation in foods and feeds is relatively untouched. The diets of many of the people must be inadequate, and it seems unsafe to use data based on products grown in the States in estimating the nutritive value of diets composed of Alaska-grown products.

Other instances of malnutrition in livestock were given by individual farmers and technical workers, including failure of cattle and sheep to breed, infertility of eggs of chickens, geese, and turkeys, poor quality of eggs, stiffness in cattle, death losses among newborn lambs, convulsions in pigs reared on garbage, and death losses among colts. Solution of these problems will require considerable study but would do much for the future of the livestock business.

It is not surprising to find that several of these instances of malnutrition were described by technical men engaged now or in the past in research on livestock. Being trained to look for the unusual they have seen more than the average farmer. It therefore seems likely that any well-conducted animal-nutrition research will uncover numerous problems that have thus far failed to attract general attention. In the field of trace elements, questions about iodine, copper, cobalt, molybdenum, fluorine, and others call for further study.[1]

The foremost issue that needs attention, however, centers around the general winter feed supply and the growing, harvesting, and storage of forages. Hay is made and stored poorly in too many cases. As already stated, it is generally cut too late and becomes weathered. Mow drying and the use of small portable driers require development and study. Silage-making machinery, silos, and silage preservation all need attention, along with choice of crops to be used.

Much use has been made of a mixture of oats, field peas, and vetch as a hay and silage crop. It is desirable to explore other crops, both annual and perennial. A beginning has been made in testing varieties of small grains, peas, and other annuals as well as perennials, both grasses and legumes. More extensive test plantings of bromegrass, timothys, bluegrasses, fescues, clovers, alfalfas, and vetch are needed for use in summer grazing, hay, and silage experiments. Increased yields as well as increased feeding values should be sought in such studies.

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[1] Cobalt analyses made through the courtesy of the U. S. Plant, Soil, and Nutrition Laboratory showed a range of 0.4 to 0.20 p. p. m. with an average of 0.11 p. p. m. for 9 samples of various grasses, mostly bluetop, and 0.19 p. p. m. in a sample of alfalfa from the Matanuska Station. Actually only one sample can be considered as seriously low in cobalt.

In silage making, for example, the harvesting and chopping of the forage and the construction of the silos, especially the trench type, have been crudely done in too many instances. Few or no grazing tests have been conducted, not only on the plantings of tame forages but on native ranges and woodland cleared in varying degrees of completeness.

There are also large tonnages of low-grade, unmarketable potatoes which may increase in the future as markets become more discriminating and competitive in this field. Better use can be made of them than is now done in feeding to livestock; one of the chief ways is as silage, cooked and preserved alone, chopped and mixed with hay, or prepared by some other method. Rutabagas are another possible feed source if reports of 20-ton-per-acre yields are reliable. Such yields should furnish more dry matter than does the average hay or silage crop.

The aim should be, first, to find ways of obtaining more plentiful and at the same time economical feed sources to supply winter feed, and, second, to work out a better balance between the farm and native range. With much land unsuited for cultivation but capable of being grazed during the growing season, the more expensive cleared and cultivated farm lands could be made to support a greater livestock population by proper complementary use of the grazing areas that can usually be found nearby.

Industrial developments should be watched for possible byproducts suited for animal feed. As an example, the expansion of the pulp and lumber industry may encourage the production of wood sugar. Such a product should have a more ready outlet as a carbohydrate feed in Alaska than in the States, where competition from blackstrap molasses and corn is so much greater.

BEEF CATTLE RAISING

The question as to what breeds of beef cattle, as well as of other livestock, are best suited to Alaska is a live topic with many people. In view of the differences of opinion in the States on the question of breeds, it is to be expected that the same will be true in Alaska. Settlers have brought their preferences with them and have plans for or are already engaged in raising cattle according to these preferences. The experience with the Galloway has left its imprint to a limited extent, but in the main the predominating preferences appear to be for Herefords, Aberdeen-Angus, and Shorthorns.

Hereford cattle where found during the exploration trip appeared to be doing well. In the Matanuska Valley only one small herd of Herefords was seen. The owner made inquiry about purchase of a bull in the States, since he was without a herd sire. Opportunities for artificial insemination are suggested by this and similar situations where herds are small and isolated and breeding stock is difficult to locate and excessively expensive to import. On Kodiak Island, two herds of Herefords have been established for a number of years. One ranch had imported Aberdeen-Angus bulls to cross on Hereford cows.

The largest herd of Aberdeen-Angus cattle is at Homer. Some interest was noted in dual-purpose Shorthorns, especially for small herds to supply family milk and meat.

There is interest also in "cattalo," developed in Canada by crossing buffaloes with cattle, and in yak crosses. There seems to be good reason to reintroduce muskoxen into mainland areas; the present small herd is on Nunivak Island. Efforts will of necessity be concentrated on a limited selection of such breeds or crosses for acclimation to the Territory, keeping in mind their adaptation to the feeding conditions. It is evident that the ability to consume and utilize forages is a prime asset because of the difficulties of raising concentrate feeds.

The management methods for the beef cattle herds range from small-farm confinement to semiopen range herding and island free range. Small herds in the Matanuska Valley and around Homer utilize small open field and woodland pastures during the summer and harvested forage, largely native bluetop, in the winter. One farmer at Homer who had a herd of 10 Aberdeen-Angus cows stored unchopped grass silage in a pit silo. His grazing season is limited to about 4 months, so he must store a considerable tonnage of silage and hay. One farmer near Palmer utilized the foothills east of the town for pasturage in the summer and as a source of hay for wintering his small herd of Herefords. About 10 years previously, one operator imported approximately 200 head of cattle and pastured them on the Knik Flats at the head of Cook Inlet and south of Wasilla. The forage was seemingly satisfactory, but after a year the effort to maintain a herd failed.

In the Kodiak area, it is customary to depend on range both summer and winter. Two ranchers visited on Kodiak Island have become interested in silage for a reserve feed supply. One was engaged in excavating for a trench silo at the time of our visit. The cattle have almost unlimited grazing range in the summer but are in danger from bears. In the winter the herds graze along the beaches, especially around the inlets or bays.

The huge brown bear is a serious if not wholly limiting factor to successful livestock production on Kodiak Island, and to a lesser extent at high altitudes on the mainland. The smaller black bear causes some trouble to livestock on the mainland. Wolves are an ever-present danger to calves and lambs on the higher, wilder ranges of the Alaskan mainland, especially near Mount McKinley Park, where they are protected from hunters. Beaver, transplanted on Kodiak Island, have increased greatly. Their numerous dams have made sedge marshes of many grass-covered valleys and developed many bogs which have proved to be death traps for cattle.

THE DAIRY INDUSTRY

The predominanating breeds of dairy cattle are Holstein, Guernsey, and Ayrshire. Most of the Ayrshires are in southeastern Alaska, where breeding stock has been imported from Canada. Holstein cows predominate around Fairbanks and Guernseys in the Matanuska Valley. The average age of the milking cows was said to be rather high because relatively few heifer calves have been raised in recent years. Young stock, especially Holstein and Guernsey, is ordinarily imported from Washington and Oregon. The wartime restrictions and other difficulties in transportation greatly reduced these importations. The low local production of replacement stock has been traceable more to costs of feeding and rearing calves than to lack of suitable sires. Nevertheless an artificial-insemination program should prove a strong incentive to the improvement of herds through locally raised heifer stock.

A number of farms are devoted largely to milk production and are well-operated. The herds on such farms range in size from 20 to 65 cows. The concentrate feeds are largely imported. In the Matanuska Valley the farmers' cooperative organization operates a small feed mill where locally grown grain can be ground and mixed with protein concentrates.

Considerable hay is also shipped in from the Pacific Coast States. The high feed costs are reflected in the high retail prices of fluid milk. At the time of the visits in 1946, the price of milk ranged from 25 cents a quart at Fairbanks to 40 cents at Kodiak, a reflection of both quality and cost of feed supplies and labor. During the war and since, the Army and Navy posts have provided a relatively large market for fluid milk as well as other dairy products to farmers in the immediate vicinity.

Comparatively little butter is made except on outlying farms in remote areas where transportation of fluid milk is out of the question. Several such instances were observed in the Homer area. There was considerable interest in ice-cream manufacture. The Matanuska Valley Cooperative Plant was manufacturing an ice-cream mix which was shipped to various points on the Alaska Railroad. One dairy at Fairbanks manufactured ice cream in a modern, well-equipped plant.

SHEEP RAISING

Sheep production problems are similar to those of beef cattle in many respects. Up to the present there has been greater emphasis on the growing of sheep on islands of the Alaska Peninsula and in the Kodiak area and less in the farming communities of the Matanuska and Tanana Valleys. These island flocks were decimated during World War II but presumably will be built up again. The foundation stock was based on importations of range sheep from the Northwestern States. The rigorous climate with its high rainfall has favored the survival of those types and individuals with a dense rather than an open fleece. For the most part, these flocks are left to graze the year round.

An interesting observation has been made about the acclimation of the sheep on Umnak and Unalaska Islands to their environment. With succeeding generations, the poorer ones not able to cope with the rigors of the climate have been weeded out by nature, so that today the animals are reported to be vigorous and of reasonable size, yielding large fleeces and good carcasses. Because of similar ancestry they have been compared favorably with the Columbia breed developed at Dubois, Idaho, which has had the benefit of scientific selection in addition to natural selection.

Comparatively few farmers in the Matanuska and Tanana Valleys or in the Homer area had sheep on their farms at the time of the 1946 survey. In no instance were flocks of sufficient size to justify employment of a herder to graze the sheep on open range outside the cultivated farm boundaries. Instead, the small flocks were maintained much as they are on farms in Wisconsin or Minnesota. The ever-present danger from bears is a strong deterrent to the keeping of sheep. Lack of sufficient cleared lands for pasturage and for growing of winter feed also limits numbers. Costs of land clearing as compared with returns from sheep have not been favorable to the sheep farmer.

There appears to be a need for a change in the experimental approach to the problem. It may be possible to develop adequate acreages for grazing without the expense of complete removal of the timber. Also, community or cooperatively managed grazing of open ranges in which flocks are combined for the summer grazing period may be the answer. The cleared land on the home farm would then be available for production of winter feed. More intensive crop production is needed, of course, to lessen the unit acreage per sheep. Greater use of root crops in the winter ration has been suggested as one means to this end. The use of silages and hays made from more productive legume crops is another possibility. Observers have also suggested that deferment of lambing from February or March to April or May may decrease the winter-feed requirement.

The need for increased meat production in Alaska naturally favors the raising of sheep with good capacities in this respect. At the same time, fleeces of the more dense type of superior-quality wool which will yield maximum returns are certainly favored. As a type, the Columbia meets most of the requirements. Some sheep of this breed were introduced in former years. Other breeds have been raised successfully, including Cotswold, Lincoln, Hampshire, Rambouillet, and Romney. For the most part, the farmers have not tried to develop or maintain flocks of specific breeds but have crossbred rams of an available breed on grade ewes. Lack of choice in breeding stock has been a limiting factor. The major need would appear to be community-wide agreement on a definite program of sheep improvement. With emphasis on a definite type of sheep, with resulting uniformity in products, a more stable and more attractive outlet for the wool crop could be established. The importation of rams of uniform breeding and of the desired type, with an artificial-insemination program especially for the small farm flocks, is suggested as the starting point.

GOAT RAISING

A limited number of farms had goats of the Toggenburg and Saanen breeds. For the most part the numbers were small and the milk and meat were consumed by the farm family. The farmer with the largest herd, which numbered approximately 25 animals, had failed to comply with sanitary regulations and was receiving no cash income from goat's milk even though possibilities for a fair volume of milk existed. Furthermore, the farm possessed the capacity to produce most of the feed supply. Most farms possess good browse pastures for goats. Winter feed needs to be provided just as for dairy cattle. Under existing circumstances very little concentrate feed is purchased, however.

SWINE PRODUCTION

The important breeds of swine are well represented in the Territory. As might be expected, choice of breeds with reference to adaptation has not presented any very important questions. Garbage feeders have generally relied on hogs of mixed breeding. In recent years, the experiment station at Fairbanks has supplied breeding stock to local farmers from its small herd of Hampshire hogs. In other instances breeding stock of different breeding has been imported from the States. Because hogs depend so largely on concentrate feeds, the swine industry in Alaska appears to face definite limitations. Emphasis must be placed on maximum use of summer forage crops, garbage from cities and military posts, and surplus and cull potatoes and other root crops unless other cheap sources of carbohydrate-rich feeds can be developed.

Garbage feeding has been developed adjacent to Ladd Field at Fairbanks and Fort Richardson at Anchorage to such an extent that pork produced from this source alone in 1946 probably equalled the entire Alaskan production in 1939. Some complaints were voiced that pork was tainted as a result of feeding garbage, and there was a report of convulsions and associated death losses among pigs reared on garbage. The foundation for these suspicions requires investigation. Management methods also need attention, as does the question of nutritional disorders in pigs.

Cull potatoes are sometimes fed to hogs on individual farms, especially when feeder pigs can be purchased. The raising of pigs for sale as feeder pigs is limited, however. On farms where several acres of potatoes are grown the amounts of cull potatoes must be considerable. It was noted that several farmers were feeding raw potatoes although they knew of recommendations that cooked potatoes had greater value as a poultry and hog feed. The ensiling of potatoes for use as cattle feed is an alternative, of course. Other feeds must be used along with potatoes, especially protein and mineral supplements. Fish meal locally produced could be the answer to the protein deficit.

Research in and demonstration of the usefulness of byproduct feeds, garbage, forage crops, and other crop residues and stimulation of the production of feeder pigs should help in increasing small-scale pork production on individual farms.

POULTRY RAISING

Poultry production in Alaska appears to be increasing at a fairly rapid rate. Chickens predominate, although a few flocks of turkeys and geese were seen. Prices of poultry meat and eggs were such in 1946 that poultry production, even though based on relatively expensive imported feeds, appeared to offer good opportunities for profit. A major obstacle was the uncertainty of delivery due to shipping difficulties.

Considerable dependence was placed on shipment of baby chicks and turkey poults from the Pacific Coast States. This practice has been accompanied by introduction of disease troubles with high death losses. Undoubtedly, lack of adequate attention and controls on the quality of the poultry stock has kept down the profits. Feeding and nutritional research has been undertaken only recently at the experiment stations at Fairbanks and Matanuska. It has already indicated that some of the feed requirements may be different from those in the States. The long winter period with attendant housing problems also calls for attention.

Undoubtedly major emphasis needs to be placed on egg production to satisfy the local markets. Thus high egg producing strains and breeds deserve attention to effect improvement in the flocks. Action is needed also to increase the local production of baby chicks from tested, disease-free flocks.

FUR-FARMING PROBLEMS

Under present-day conditions, the profitable production of fur animals in Alaska would seem to demand evaluation of different areas as to transportation facilities and shipping costs; availability of adequate local supplies of fish products and other feeds to reduce the need for imported materials; cold-storage facilities; availability of labor; and consideration of favorable sites and housing. In general, inland areas seem to be ruled out. The southern coastal area along with the southeastern Panhandle remains the preferred region. The survey made in 1946 took these factors into consideration.

The Kodiak area possesses most of the desirable features of climate, availability of fish and marine products, and cold-storage and transportation facilities. Cordova is another location with favorable conditions. Of the various towns on the Kenai Peninsula, Seldovia possesses advantages over such places as Homer and Kenai because of fish supplies. It is likely that fur farms will continue to be operated at Homer and other points on the Kenai Peninsula, however.

In the Anchorage area, fish supplies are limited, and operations are likely to be limited in size. The numerous fishing centers in the Panhandle, added to lower freight rates from Seattle and other shipping ports, favor lower feed costs there as compared with those in more distant points.

Fur farming on a part-time basis is definitely indicated in favorable locations as a means of supplementing the family income, which is often seasonal through employment in the fishing industry, construction work on military bases and roads, and other occupations.

Although fox and mink raising ranks first in importance, there is interest in other fur-bearing animals, including marten, muskrat, and beaver. Possibly emphasis on fox raising needs to be lessened except where production costs can be kept low enough to permit the sale of pelts on a profitable basis. Improved breeding stock is a primary need for both mink and fox farming. Studies on other animals, including those named, are needed.

Studies at the Petersburg Experiment Station have revealed various problems in the use of fish products in the diet which must be solved if this feed source is to take its rightful place in fur-farming operations.

LIVESTOCK DISEASES AND PARASITES

By Harry E. Kemper, *veterinarian in charge, Zoological Division Field Station, Albuquerque, N. Mex., Bureau of Animal Industry*

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Like the human population, the domestic livestock population of Alaska is small. Because of the short growing season, it is difficult to raise and mature feed crops. Pasture feeds, always scarce, are virtually nonexistent during the long winter season, and feeds shipped in from the States bring exorbitant prices. As a result, the Alaskan livestock industry is naturally limited. The 1939 Census figures on numbers of livestock in the Territory are given in Chapter 5, page 168.

Most of the dairy cattle in Alaska are adult animals, since it seems more economical to butcher calves and to import producing adult dairy animals of good quality than to attempt to rear dairy calves. The cost of feed in Alaska, with alfalfa shipped in from the States to central points in the Territory at a cost of about $100 a ton, is a determining factor in livestock farming.

Machinery powers the Alaskan farm, and draft animals are negligible in number. Most of the hundred-odd horses are of saddle types.

Reindeer and caribou constitute an important source of meat for the native populations. Some 75,000 of these animals now inhabit the coastal plains and adjacent islands in the Bering Sea. This is a marked reduction from the 200,000 estimated to have existed in 1940–41.

HEALTH STATUS OF ANIMALS IN ALASKA

The Alaskan livestock industry is exceedingly fortunate in that it has so far had no serious disease problems. Probably largely because livestock are relatively scattered, only a few of the infectious diseases have become established. External parasites are of minor importance, except for lice on poultry and a very few lice on cattle, and only in rare instances do internal parasites appear troublesome.

Feeding livestock is an important problem, as would be expected in view of the limited quantities of range, pasture, and feeds and the short grazing season. Poisonous plants take their toll, but no estimate of the extent of such losses can be made at present. Probably more destructive and certainly more annoying to the animals than all other causes of ill health are the biting insects which make life in Alaska disagreeable for animal and man alike during the summer months.

RANGE PROBLEMS

FORAGE ON RANGE AND PASTURES

The summer cattle-grazing season in the southern farming areas of Alaska, the Matanuska Valley and the Homer area, does not exceed 5 months and is frequently even shorter. The principal native grass is the bluetop (*Calamagrostis* sp.). With this grass are generally found fireweed (*Epilobium*), equisetums, and ferns. Horses have been known to winter out with no supplemental feeding, subsisting largely on beach rye (*Elymus*), found in protected coves along the beaches of the lower Kenai Peninsula.

In the Kodiak area, it is possible in average years to graze cattle all winter on grass and a heavy undergrowth of willow, elderberry, and other brush. Ranchers in this locality manage to put up some hay and silage, which is used to feed the poorer animals during late winter and early spring.

Native grasses in the Tanana and Matanuska Valleys grow abundantly but cannot withstand close grazing or repeated annual cutting for hay. Tame pastures of yellow-flowered alfalfa, field peas, and white and alsike clover are successful, especially in the Palmer and Fairbanks areas. However, in some years these crops are made into silage for winter feed, especially in seasons of excessive rainfall.

POISONOUS PLANTS

Poisonous-plant investigations in any given area invariably require exhaustive feeding tests and prolonged observations. Plants which may prove harmful to animals in one area frequently constitute satisfactory forage in another.

It appears certain that the larkspur (*Delphinium* sp.) and water-hemlock (*Cicuta* sp.), particularly in the Palmer, Juneau, and Homer areas, are responsible each year for some livestock losses. It is also reported that on Unalaska Island, in the Aleutians, sheep develop the habit of eating giant seaweeds. Such animals are locally known as habitual kelp eaters, and the symptoms they manifest are similar to those resulting from the consumption of loco plants in the southwestern part of the United States. Alaskan stockmen regard the *Lupinus arcticus* as a good forage plant and do not look with particular suspicion on members of the horsetail family, Equisetaceae, or the fern family, Polypodiaceae. They do, however, fear the skunk cabbage, or false hellebore (*Veratrum*), which grows abundantly in the coastal region of southeastern Alaska.

DISEASES AND PARASITES

CATTLE

Mastitis is a universal disease of cattle, and milk cows in Alaska are no less affected than those in the United States and Canada. Cows in Alaska are similarly subject to a variety of inescapable ailments, among them foot rot and traumatic pericarditis. Bovine tuberculosis, as shown by tuberculin tests, is present to an extent of about one-half of 1 percent, and brucellosis is much more extensive. These diseases receive constant attention by Territorial veterinarians. During 1945–46, 1,322 dairy cows were tuberculin tested, and the 7 reactors were immediately destroyed. Only one dairy herd in the Palmer area is now considered brucellosis positive, but some herds in other areas harbor the disease. Blackleg and anthrax are apparently nonexistent, and actinomycosis is extremely rare.

Alaskan cattle show little evidence of harboring external parasites. Investigations conducted during the summer of 1946 revealed no lice on cattle, despite careful scrutiny. After these examinations, however, during the winter of 1946–47, a few lice were found on cattle in a Juneau dairy herd by the Territorial Veterinarian. Cattle grubs, the larval stages of the heel flies *Hypoderma lineatum* and *H. bovis*, also appear to be absent in the Territory. In any event, no evidence of them was found during the summer of 1946. Although grub-infested cattle have been imported, the adult heel fly has apparently not been able to establish itself in the Territory. No intestinal parasites and no liver flukes have been identified in any cattle that were examined.

HORSES

Horses, like cattle, are subject to minor ailments in Alaska but not to serious epizootics. Strongyle infestation of pathogenic proportions is reported, but no other parasitic infestations were encountered.

SWINE

Alaskan swine subsist almost entirely on garbage obtained from military posts at Fairbanks and Anchorage. Immunization against hog cholera by the simultaneous method is carried out as a routine practice when pigs are 8 to 10 weeks old. The immunization program is almost entirely conducted under the supervision of the Territorial Veterinarian. Tuberculosis is present to some degree in swine. Pyogenic abscessation is very common in Alaskan swine and is attributed in part, at least, to insanitary husbandry practices. Ectoparasites were apparently nonexistent during the summer of 1946, and endoparasites were exceedingly few in number. A few light infestations of *Ascarops strongylina* were found.

SHEEP AND GOATS

The sheep tick, *Melophagus ovinus*, was found in only 1 to 10 small bands of sheep in the Matanuska Valley. No true ticks were seen. Internally, Alaskan sheep are not quite so fortunate. They harbor the stomach worm (*Haemonchus contortus*), the brown stomach worm (*Ostertagia* sp.), the black scour worm (*Trichostrongylus* sp.), the thin-necked worm (*Nematodirus* sp.), and a variety of coccidia as well. None of these parasites, however, was present in pathogenic numbers.

POULTRY

Diseases of poultry are not uncommon in both the Fairbanks and Palmer areas. Enterohepatitis was observed in the turkeys at the Agricultural Experiment Station farm at Fairbanks, where, despite extreme vigilance in the care of the flock, the disease proved quite destructive. In the Palmer area, 4 of 8 flocks of chickens closely examined were affected with coccidiosis. Chicken lice were commonly seen, and all proved to be the common body louse (*Menacanthus stramineus*). Faulty nutrition accounts for part of the poultry losses of obscure origin in the Palmer area.

REINDEER AND CARIBOU

Reindeer and caribou suffer from a variety of ailments, almost all of which can be attributed directly or indirectly to parasitic infestations. In summer these animals are plagued by the relentless attacks of insects, the most notorious of which is the warble fly, *Oedemagena tarandi.* The reindeer warble fly operates in much the same manner as the ox-warble in the States. Yearlings frequently harbor from a few to as many as several hundred larvae under the hide of their backs. The nostril fly (*Cephenomyia trompe*), though less spectacular than the warble fly, causes even more annoyance. The adult flies terrify the animals, and the mature larvae or grubs, which are found attached in the pharyngeal region of the nasal passages, produce considerable suffering. Blowflies (*Protophormia terrae-novae*) are found in abundance on the coastal ranges, and their maggots infest reindeer with serious results. The most important factor predisposing reindeer to infestation with fly maggots is the warble fly. When the warble larvae emerge from the reindeer in the spring, large openings filled with pus—sometimes hundreds of them—may be seen in their backs. Blowflies are attracted to these, and in some seasons considerable losses may follow. Flies in general, but chiefly the warble flies, are responsible for serious and often fatal cases of dermatitis. During the fly season in July and August, huge, badly infected skin lesions are so numerous, particularly on young animals, as to be a tragic sight.

Among the nonparasitic illnesses of reindeer and caribou are a dermatitis, foot rot, and corneal keratitis, an inflammation of the eyes.

INSECTS AFFECTING ANIMALS

Both animals and man suffer severely from insect attack during the summer in Alaska. Since animals are unable to protect themselves fully from insects, their plight can well be appreciated. Horseflies (Tabanids), midges (Culicoides), buffalo gnats or blackflies (Simuliidae), and mosquitoes are present from June through August in unbelievable numbers everywhere in Alaska. Swarms of these pests torment animals relentlessly and with great ferocity throughout the warm months. Horses, cattle, and reindeer particularly are bitten until they are often a mass of welts. Sheep and swine are not immune from such annoyance and are readily bitten about the face and ears.

SUGGESTIONS FOR IMPROVED AND EXPANDED LIVESTOCK MANAGEMENT

The correct feeding and more careful selective breeding of cattle, swine, and poultry will do much to improve the quality of livestock on Alaskan farms. In addition, the application of elementary principles of sanitation will do much to control disease. Foot rot and mastitis in cattle and pyogenic abscessation in swine could be markedly reduced in this manner.

PREVENTION OF TRANSMISSION OF ANIMAL DISEASES TO MAN

No provision is currently made in Alaska for the ante mortem or post mortem examination of meat and meat products intended for human consumption. Most communities are too small to afford adequately supervised slaughter houses, but there is no denying the need for such facilities.

The veterinary inspection of dairy installations and dairy products is also much needed in Alaska.

The Territorial Veterinarian has an office at Palmer and there is an Assistant Territorial Veterinarian at Juneau. Their work consists in part of tuberculosis and brucellosis control in Alaskan dairies, and they also investigate a wide variety of animal disease problems. It is readily apparent that this office operates efficiently and effectively. With added personnel and facilities, the examination of abattoirs, meat and meat products, dairies, and milk and milk products could be undertaken at relatively small cost.

PREVENTION OF DISEASE INTRODUCTION

Because new and replacement animals are transported to Alaska largely by boat, with a few by truck, it should not be difficult to maintain rigid supervision of such importations from the standpoint of infectious disease and, to a lesser degree, of parasitic infestation. It appears evident that many of the infectious and parasitic diseases common to cattle have not yet become established in Alaska, and this emphasizes the need for rigid quarantines against the further introduction of any cattle affected with such diseases.

POSSIBILITY OF EXPANSION

The opportunity for the expansion of the livestock industry in Alaska is currently not great. The numbers of beef cattle must necessarily remain small because of limited range and the extremely long winter feeding season. The swine population is also limited, depending as it does largely upon available garbage from cities and active military posts. There is room, however, for growth in the direction of dairying and poultry farming. The present demand in Anchorage alone far exceeds the present available supply of both dairy and poultry products from the Palmer agricultural area. The Matanuska Valley appears highly suitable for considerable further development along these lines.

REFERENCES

Reindeer Management Handbook (unpublished field notes of the late L. T. Palmer, Alaska Native Service, Juneau, Alaska); Keeping Livestock Healthy, 1942 Yearbook of Agriculture, U. S. Department of Agriculture.